

Biological Assessment for the Removal of Sodom Dam and Shearer Dam DRAFT

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for
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Acronyms and Abbreviations

BA	Biological Assessment
FR	Code of Federal Regulations
CID	Calapooia Irrigation District
CWA	Clean Water Act
dB	decibel
dBA	adjusted decibel
DPS	Distinct population segment
EFH	essential fish habitat
ESCP	Erosion and Sedimentation Control Plan
ESU	evolutionarily significant unit
fps	feet per second
FR	Federal Regulation
MSA	Magnuson-Stevens Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity units
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
ODSL	Oregon Department of State Lands
OPRD	Oregon Parks and Recreation Department
OSU	Oregon State University
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
PCE	primary constituent element
RM	river mile
SWCD	Linn County Soil and Water Conservation District
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
UWR	Upper Willamette River

1 INTRODUCTION

The Sodom and Shearer dams, located on the Sodom Ditch and Calapooia River in the lower Willamette Valley in Oregon no longer serve their original purpose and are impediments to fish passage. Oregon Parks and Recreation Department (OPRD) purchased the property known as the “Thompson’s Mills” (Mills) from a private owner in 2004. The sale included a permanent easement for operating and managing the three dams associated with diverting water to the Mills: Sodom Dam, Shearer Dam and Spillway Dam (Spillway Dam has not been identified as a fish passage barrier and alternatives for its future management are still in development). OPRD intends to go “off-line” with their demonstration milling water needs and develop an alternate water delivery system rather than necessarily depend on surface water diverted from the Calapooia River. This decision by OPRD means that the Sodom Dam and Shearer Dam are no longer necessary and these barriers to passage for two ESA threatened species, Upper Willamette River winter steelhead and Upper Willamette River spring Chinook, can be addressed.

As the agency providing federal funding for this project, National Marine Fisheries Service (NMFS) authorized this Biological Assessment (BA) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) to ensure that the proposed action of dam removal is not likely to jeopardize the continued existence of listed species. NMFS reviewed current information about the distribution of listed species in the area from studies by state and local agencies, status reviews by NMFS and U.S. Fish and Wildlife Service (USFWS).

In addition, this BA also addresses potential effects on essential fish habitat (EFH) as required under the Magnuson-Stevens Fishery Conservation and Management Act (as amended by the Sustainable Fisheries Act of 1966 [Public Law 104-267] – see Section 11.0).

2 BACKGROUND

The Sodom and Shearer dams are operated by OPRD to manage operational flows delivered to the Mills. The Mills became a State Heritage Site in 2004, with the property’s special significance being the oldest water-powered grain mills in the state. A system of waterways, dams, control gates, ditches and dikes have diverted water from the Calapooia River to the Mills’ head gates since 1858.

The Sodom Ditch was built in the late 1800s upriver of the Mills. Sodom Ditch is believed to have been excavated either to serve as a high water over-flow channel to divert water around the Mills and minimize flooding along that reach of the Calapooia River, or as an irrigation ditch. As the ditch eroded into the fine valley soils, Sodom Ditch became too effective and shortly after its construction, began to capture nearly the entire flow of the Calapooia River. Sodom Dam was first built around 1890 to create sufficient head to backwater river water during low flows out of the Sodom Ditch and back into the Calapooia River. From 1890 to 1956, Sodom Dam evolved from a push-up dam that was seasonally installed to divert flows during the summer months, to a more permanent timber crib dam filled with rock ballast. The current concrete dam was built in 1957 after an earlier concrete structure built in 1954 failed in 1956.

Similar to the Sodom Dam, when first built in 1890, Shearer Dam’s function was to divert flows from the Calapooia River into a hand-dug channel that connected with Walton Slough. This connector channel (Upper Millrace) routes flow into Walton Slough, the main conveyance supplying water to Thompson’s

Mills. Shearer Dam was also a push-up dam later replaced by a timber crib structure and finally a concrete structure in 1956.

The Mills historically operated to provide water power for the Mills' grain processing facility. The Mills operated in this fashion for over 120 years, milling various grains including wheat and barley. Beginning in the 1970s, it was no longer economically feasible to grind grain – little grain was being produced in the area - and the Mills began to instead generate electricity that was sold to the energy company PacifiCorp. The 1999 listing of Upper Willamette River (UWR) winter steelhead and spring Chinook as “threatened” under the federal Endangered Species Act (ESA), spurred state and federal natural resource agencies to examine this site more closely when the Mills' Federal Energy Regulatory Commission (FERC) license was up for renewal. NMFS, the federal agency responsible for enforcing the ESA, determined fish passage at the dams associated with the Mills would be a necessity if the property were to renew its FERC license. This led to a lengthy multi-year discussion between the natural resource agencies, PacifiCorp, Oregon Water Trust (now The Freshwater Trust) and the private owner over how to satisfy the regulatory framework (cascading from the ESA listing) in order to surrender the property's FERC license. After several years of discussions and negotiations, in 2004 OPRD purchased the Mills and associated dams from the private owner. Also in 2004, the dam's private owner sold 12 cfs of the property's historic 1858 water rights to the Oregon Water Trust for transfer to in-stream rights.

Over-arching problems associated with the managed water system include the following (details on the concerns with each dam are outlined in subsequent sections):

- Current water control facilities are inadequate to ensure water availability for fish in the Calapooia River, and flows are too warm in Sodom Ditch during hot summer months to support migrating and juvenile fish.
- Prior to this technical assistance and outreach effort, there had not been community outreach efforts to develop a sustainable solution to the managed flow system that is dependent on Sodom Dam, a significant partial barrier to fish passage.
- The Calapooia River – Sodom Ditch channel split, referred to as the bifurcation, becomes plugged with sediment and woody debris and requires maintenance in order to maintain base flows in the Calapooia River channel and satisfy Calapooia River water rights owners.
- Salmonid spawning and rearing habitat is predominantly upstream of the dams. Steelhead and Chinook must negotiate either Sodom Dam or Shearer Dam in order to reach preferable spawning habitats in the upper watershed.

The following sections provide additional detail on the dam structures and channels in the action area.

2.1 Bifurcation

The bifurcation is a branch in the Calapooia River signifying the start of the Sodom Ditch. At the bifurcation a mostly natural arm of the Calapooia River splits and flows to the northwest. Thompson's Mills is built on a second branch from the Calapooia River about 6 ½ miles downstream from the bifurcation. The eastern branch at the bifurcation is the Sodom Ditch. The Sodom Ditch was initially dug as an irrigation ditch or high water bypass channel (Crispin 2010). Sodom Ditch has increased in size to become a naturalized channel. The Sodom Ditch joins Butte Creek before returning to the Calapooia River downstream from Thompson's Mills, about 7 miles downstream from the bifurcation.

2.2 Sodom Dam

Sodom Dam is located approximately 1,400 ft downstream from the bifurcation. A push-up dam predated the original pile or frame dam that was constructed in 1890 to provide more water to Thompson's Mills as the Sodom Ditch was drawing too much water from the Calapooia River at the bifurcation (Crispin 2010). A concrete dam was constructed in 1954 and replaced in 1957 following the dam's failure in 1956. The existing concrete dam is approximately 85 ft across and 8 ft – 4 inches high. The sides of the dam are bounded by concrete abutments that extend to a height of 10 ft above the crest of the dam. The abutments have concrete wing walls that extend into the streambanks. Flashboards can be added to the dam spillway to raise the water surface in Sodom Ditch. One set of 12 inch flashboards is typically added to the dam during the irrigation season.

A pool and weir fishway is located on the river-left (west) side of the dam. The fishway includes six pools and is susceptible to debris plugging during winter high flows. The ladder's individual step heights do not meet Oregon Department of Fish and Wildlife (ODFW) or NMFS criteria.

Problems associated with the Sodom Dam include:

- The dam is an aging structure that is reaching its as-built life expectancy.
- There is significant deterioration of the fishway's concrete with daylight visible through the fishway wall in a number of locations. Flows seep through the wall of the fishway. Two of the six pools have severe abrasion from bedload scour with exposed rebar along the walls and floor.
- Some areas of concrete along the scour apron and lower portion of the dam have deteriorated or been abraded by bedload. Exposed rebar is evident at the toe of the three buttresses.
- Scour under the outlet apron exceeds 4 ft.
- The existing fishway does not meet current design criteria established by ODFW and NMFS. It does not have the appropriate jump/drop height in the pools. Attraction conditions during high flows are inadequate because the first two pools of the fishway are submerged. Attraction conditions during low flows prevent migrating fish from finding the inlet to the ladder because the fish congregate at the spillway where flows are higher. The ladder is frequently non-functioning due to accumulated debris from winter storms that is not removed because there is no access to the fishway during high flow conditions (the fishway is on the opposite bank from the only road to the dam).
- Steelhead have been observed spawning in Sodom Ditch. Spawning in this channel is a concern because juvenile winter steelhead are unlikely to survive the high summer water temperatures in this reach. Spawning downstream of Sodom Dam may be an indication of a fish passage barrier.
- Sodom Dam interrupts movement of gravels in Sodom Ditch.

2.3 Shearer Dam

Shearer Dam is located on the Calapooia River at RM 23.5. The original dam was likely a gravel push-up dam that was later replaced with a log crib structure that was built in 1858 (Crispin 2010). The existing Shearer Dam was built in 1956 and is the primary diversion dam for Thompson's Mills (Crispin 2010). Measuring approximately 5 ft high and 35 ft long, the concrete dam includes lateral wing walls, a spillway that can be modified with flashboards, and a fishway on the river-left (west) side of the dam.

The existing weir and pool fishway is comprised of three pools 6 ft wide by 9.5 ft long by 3 ft deep. The weir and pool fishway is susceptible to debris plugging during winter high flows. The ladder's individual step heights do not meet ODFW or NMFS criteria.

Shearer Dam maintains sufficient water surface elevations to divert water to Thompson's Mills via the Upper Millrace connector ditch. The Upper Millrace joins Walton Slough (formed by Courtney Creek and Spoon Creek), a natural channel that is believed to have been dredged approximately a half mile upstream of Roberts Road in the 1960s (Crispin 2010). OPRD currently maintains a stream flow gauging station immediately upstream of Shearer Dam.

Problems associated with the Shearer Dam include:

- The fishway does not meet current fish passage criteria and does not provide passage during low flow conditions, due to the presence of rock ballast at the outlet that extends above the water level.
- Additionally, the fishway pools are not appropriately sized, creating adverse hydraulic conditions for fish passage. Under stagnant conditions the fishway is a barrier to fish. At low stream flows the flow depth may be too shallow for fish to traverse and jump into the fishway entrance.
- Disruption of sediment transport through the dam site.
- Elevated water surfaces upstream of the dam and increased flooding potential of area properties due to diminished channel capacity.

2.4 Connector Ditch to Millrace

The connector ditch, also known as the Upper Millrace, is approximately 450 ft long, 30 ft wide, and 6 ft deep. The Upper Millrace diverges from the Calapooia River upstream from Shearer Dam and parallels Roberts Road before joining the Walton Slough/Millrace channel. The Millrace ultimately delivers water to Thompson's Mills. Adding flashboards to Shearer Dam increases the water surface elevation of the dam and permits more water to be diverted to Thompson's Mills during baseflow periods.

The history of the Upper Millrace is unknown although it is believed to either have been originally hand dug or was possibly excavated with a horse and plow (Crispin 2010). Over the years, the Upper Millrace enlarged likely through natural erosion and possibly through mechanical excavation. Due to a lack of maintenance, trees have fallen into the connector ditch and vegetation has encroached on the channel margins.

These dams have been known fish passage problems for decades, but because of their complexity and lack of a simple, inexpensive solution, no concerted effort has been made to address them. Over the past eight years, the Calapooia Watershed Council (CWC), with the support of an active Technical Team composed of local, state and federal natural resource officials and local landowners, has built the relationships and done the outreach necessary to obtain stakeholder support for removal of the Sodom and Shearer dams.

3 INTER-AGENCY CONSULTATION ACTIVITY

CWC developed a cooperative agreement with OPRD in 2008 to designate project roles and responsibilities, where the CWC would engage local landowners in participating in developing and evaluating project alternatives. As of August 2010, the CWC planned and facilitated twelve landowner/technical team sessions to discuss what the stakeholders envision for long-term management of the river system and to determine the technical information needed to move the project forward. The project's Technical Team is composed of affected landowners and representatives of:

- Calapooia Watershed Council (CWC)
- Oregon Parks and Recreation Department (OPRD)
- Oregon Watershed Enhancement Board (OWEB)
- Oregon Department of State Lands (ODSL)
- Oregon Department of Fish and Wildlife (ODFW)
- Oregon Water Resources Department (OWRD)
- Oregon State University (OSU)
- Linn County Soil and Water Conservation District (SWCD)
- Linn County
- Calapooia Irrigation District (CID)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Army Corps of Engineers (Corps)
- National Marine Fisheries Service (NMFS)
- Oregon Department of Transportation (ODOT)

Consultants provided technical information and reports throughout the CWC's outreach process to answer questions pertaining to river processes and management and to provide information to facilitate discussions and decision-making. Technical documents include:

- River Design Group, Inc. 2009a. Sodom Dam Fish Passage and Dam Removal Preliminary Alternatives. 7 pp.
- River Design Group, Inc. 2009b. Calapooia River – Sodom Dam Project Alternatives and Hydraulic Modeling Scenarios. 19 pp.
- River Design Group, Inc. 2009c. Calapooia River Geomorphic Assessment Sodom Dam Bifurcation to Butte Creek Confluence. 80 pp.
- River Design Group, Inc. 2009d. Hydraulic modeling summary for Sodom Dam Alternatives Feasibility Study. Technical Memorandum. 12 pp.
- Calapooia River and Sodom Channel Hydraulic Model for Current and Proposed Conditions, River Design Group, in progress (River Design Group, Inc. 2010).

The local community has a vested interest in the restoration of the Calapooia River and Sodom Ditch. Several landowners have dedicated significant time to attending these meetings, which included an analysis of project alternatives. The preferred alternative was developed with feedback from landowners and agency staff and considers the economic realities of implementing the project. The preferred alternative includes the most supported components presented in the original alternatives. The preferred alternative is one that is achievable with available funding and is a solution that addresses the project's objectives for fish passage, water delivery for landowners, and reduces flood risk.

The project has received funding from several competitive grant sources including: OWEB, American Rivers, and the NOAA Restoration Center. The CWC contracted River Design Group, Inc. (RDG), to provide engineering services including a geomorphic assessment of the project area and hydraulic modeling of the Calapooia/Sodom system. Project documents and reports can be viewed on the CWC's webpage: <http://www.calapooia.org>.

RDG worked with CWC to provide a series of informational meetings for landowners and Technical Team members that provided an overview of the Calapooia River, geomorphic processes, and a hydraulic model of the system that provide the foundation for evaluating the project's alternatives. RDG then developed six project alternatives, which were presented to the landowners and Technical Team. Over the course of several meetings and many discussions during 2008-09, the Technical Team developed a proposed solution for implementation that was unanimously agreed to be the best alternative for implementation. This preferred alternative includes: (1) Removal of both Sodom and Shearer dams, (2) Installation of in-stream grade control in Sodom Ditch to maintain flows in both channels, and (3) Reconfiguration of the bifurcation to minimize gravel deposition and decrease maintenance requirements. The project can now move forward with implementing this preferred alternative with the full support of all agency and landowner representatives.

The Technical Team meetings took place in Linn County at two locations: Shedd and Halsey. One meeting was held in Marion County at the OPRD office in Salem. Meeting summaries are available on the CWC's webpage <http://www.calapooia.org> and are briefly summarized here:

- | | |
|---------------|---|
| November 2008 | Landowner meeting that provided a presentation on CWC's history, formation and background with the project. Landowner interactive survey was conducted to gauge knowledge of and interest in the project. Landowner discussions on project concerns and interest in future participation with the project. |
| December 2008 | Meeting with the CWC and OPRD to share project history, clarify roles and responsibilities for project partners, review grant status, discuss Technical Team member invitations and review results from landowner meeting. |
| February 2009 | Landowner meeting with presentations from the CWC, ODFW and RDG on: project timeline, fisheries conditions in the watershed, and historic conditions in the Calapooia River and Sodom Ditch. Purpose of the meeting was to build common knowledge of the geomorphic characteristics of the Calapooia/Sodom system (soils, underlying geology, land and water interactions) and how the various stakeholders view and value the landscape and water resources. |
| February 2009 | Technical Team meeting with presentation from OPRD on lessons learned from their work on identifying project alternatives in 2006, and a presentation from RDG on historic conditions in the Calapooia River and Sodom Ditch. |
| May 2009 | Technical Team meeting with presentation from RDG on the five identified alternatives for the system and the conclusions from the project's geomorphic study. Purpose of the meeting was to solicit feedback from the Technical Team members on their agency's view of the proposed alternatives. This meeting was also an opportunity for agency staff to identify any areas for additional data collection or unresolved questions so that decisions on modeling and data collection could be made. |

- May 2009 Landowner meeting with a presentation from RDG on the project's five alternatives. The meeting was held following the Technical Team meeting in order to provide landowners with the feedback from state and federal agencies on the permitting or other concerns for each alternative.
- August 2009 At this point, the project moved to a joint Landowner/Technical Team meeting with a project overview from the CWC and presentations from several Technical Team representatives. This meeting was to discuss the various project concerns and constraints associated with each of the project's five alternatives. Interim management concerns were reviewed, project cost for each alternative and an overview of the hydraulic modeling for the project was presented by RDG.
- September 2009 Joint landowner/Technical Team meeting to provide the results of the project's hydraulic model and to discuss how to allocate flow at the bifurcation between the two channels. The CWC presented a combined project alternative, formed out of the previous months of discussion that was combination of components from the previously identified five alternatives. The group agreed to take this proposed combined alternative back to their representative groups to gauge support for it from their agency/other landowners and be ready to give a recommendation at the next month's meeting.
- October 2009 Joint landowner/Technical Team meeting with a question/answer session on the proposed combined alternative and various future scenarios (flooding, drought, project design not working as intended, etc) to talk through the various potential complications of the project's implementation and future management of the site.
- December 2009 Landowner meeting geared specifically toward landowners that had not been in attendance at the previous meetings, but who have a vested interest in the project because they are either irrigators or adjacent property owners. CWC provided an overview of the original five alternatives and the proposed combined alternative. Landowners had the opportunity to ask questions and to view project maps, drawings, etc.
- December 2009 Joint landowner/Technical Team meeting to come to a decision on whether to move forward with the proposed combined alternative. The meeting was devoted to a question and answer session with agency staff and landowners contributing to the RDG presentation. The end of the meeting was consensus from the group to move forward with dam removal and channel restoration.
- May 2010 Project re-grouping. After nearly 5 month hiatus due to funding constraints, project re-grouped to discuss the FERC surrender application components, 50% design for Sodom and a conceptual design for Shearer, and begin discussions on the project's Monitoring and Maintenance Plan.
- June 2010 Focus of this meeting was on review of the project's 75% design for Sodom, 25% design for Shearer. There was also discussion on what the trigger would be for Summer 2010 maintenance at the bifurcation if low flow conditions coupled with sedimentation at the entrance to the Calapooia River prevented adequate flows from accessing the Calapooia branch. The project's Monitoring and Maintenance Plan was introduced and it was decided that a smaller sub-group

of the Technical Team would meet to review and make recommendations for the post project monitoring and maintenance.

- November 2010 *To be scheduled.* Landowner meeting. Purpose of this meeting will be to provide an overview of the project's final design. Landowners who need to provide permission for access will have the opportunity to view the staging areas, project footprint and proposed access routes.
- November 2010 *To be scheduled.* Permit agency 90% design review. Purpose of this meeting will be to allow agency review and comment on the project's designs prior to submittal for permits. Any final comments and concerns will be addressed.

4 DESCRIPTION OF PROPOSED ACTION

This section describes the methods for removal of Sodom Dam and Shearer Dam and restoration of proposed activities at the former dam sites. During project planning, project stakeholders considered six alternatives for the project area. The alternatives included:

- Alternative 1: No Action - maintain existing river corridor conditions and management.
- Alternative 2: Fish Passage – maintain existing river corridor conditions and management but provide fish passage at each diversion structure including Sodom Dam, Shearer Dam, and Spillway Dam.
- Alternative 3: Remove the dams and restore the Calapooia River as the primary channel.
- Alternative 4: Remove the dams and maintain Sodom Ditch as the primary channel.
- Alternative 5: Remove the dams and institute variable flow management transitioning from Sodom Ditch as the main channel to the Calapooia River as the main channel over time.
- Alternative 6: Remove the dams and maintain existing flow partitioning.

The No Action alternative was not selected as OPRD is required by FERC to bring operation of the Thompson's Mills facility and supporting infrastructure in-line with endangered species regulatory requirements. Upgrading Thompson's Mills, Sodom Dam, and Shearer Dam to meet regulatory requirements was deemed exceedingly expensive.

The Fish Passage alternative was not selected due to on-going liability and maintenance associated with providing fish passage and the ensuring the integrity of Sodom Dam and Shearer Dam. This alternative also did not address larger scale instability of Sodom Ditch and the Calapooia River.

The Restore the Calapooia River alternative, included removing Sodom Dam and Shearer Dam and actively increasing the channel capacity of the Calapooia River downstream from the Calapooia River – Sodom Ditch bifurcation. This alternative was not selected due to the expected high cost of reconstructing the Calapooia River so that it would convey the estimated channel-forming discharge.

The fourth alternative, the Maintain Sodom Ditch alternative, included removing Sodom Dam and Shearer Dam and allowing the Calapooia River channel downstream from the Calapooia River – Sodom Ditch bifurcation to naturally fill over time. As the Calapooia River channel filled with sediment, wood, and vegetation, the Sodom Ditch would capture more flow. Ultimately, the Calapooia River channel

would not be active during baseflows but would convey flood flows during high water events. This alternative was not selected due to the stakeholders' interest in maintaining the Calapooia River as an active base flow channel for in-stream habitat benefits, fish passage, and to satisfy Calapooia River water users.

The Variable Flow alternative included replacing or retrofitting Sodom Dam with a variable elevation structure that could be adjusted over time to control the distribution of flow between the Calapooia River and Sodom Ditch. This alternative was not selected due to project cost and the need to maintain the variable flow structure over time.

The final and preferred alternative, Dam Removal and Maintain Existing Flow Partitioning, contains elements of the previous alternatives and was arrived at through multiple stakeholder meetings attended by local residents and regulatory agencies. The preferred alternative includes removing Sodom Dam and Shearer Dam and maintaining the existing flow distribution between the two channels. Sodom Ditch from the bifurcation to downstream of the existing dam site will be reconstructed to ensure channel stability and provide fish passage. The Calapooia River through the Shearer Dam site will also be modified for channel stability, fish passage, and habitat.

4.1 Action Area

The action area for this project includes all areas to be affected directly or indirectly by the action, in addition to the immediate area involved in the action. The action area includes the channel bed, bank line, riparian area, and aquatic habitat affected by the proposed actions for both the Sodom Ditch and the Calapooia River. For this project, the action area encompasses the following locations:

- Calapooia River 200 ft upstream of the Calapooia River – Sodom Ditch bifurcation, to the bifurcation,
- Sodom Ditch from the bifurcation to 1,650 ft downstream of the bifurcation and 200 ft downstream from Sodom Dam,
- Calapooia River from the bifurcation to 200 ft downstream of the bifurcation,
- Calapooia River from 200 ft upstream of Shearer Dam to 200 ft downstream of Shearer Dam, and
- Connector ditch/Upper Millrace from the Calapooia River, downstream 450 ft to Walton Slough.

Figure 4-1 and 4-2 include site maps for both the Sodom Dam and Shearer Dam sites, respectively.



Figure 4-1. The Sodom Dam project area.



Figure 4-2. The Shearer Dam project area.

4.2 Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. Interrelated or interdependent activities are measured against the proposed action. There are no interrelated or interdependent actions associated with this proposed action because the dam removals and channel reconstruction efforts would not affect the use of the Calapooia River or Sodom Ditch in terms of water withdrawals or recreation.

4.3 Proposed Action

The removal of Sodom Dam and Shearer Dam would occur in four phases during the in-water work season. Sodom Dam would be demolished first followed by the removal of Shearer Dam. The Sodom Ditch reconstruction is to follow completion of the Shearer Dam work. Reconstruction of the Calapooia River channel at the bifurcation will be the final project element.

4.3.1 Phase 1: Sodom Dam Removal

The removal of Sodom Dam will be completed by isolating the work area from clear water and removing the dam. A cofferdam will be constructed immediately downstream of the bifurcation at STA 26+50. A 24 inch culvert will be installed in the cofferdam to allow controlled flow through the cofferdam. The culvert will convey up to 13 cfs to flow through the cofferdam which will also serve as a temporary crossing. Streamflow exceeding 13 cfs would be backwatered and flow down the Calapooia River (see Appendix A Resource Maps). The cofferdam will be used to regulate streamflow to the work area as well as provide vehicle access to river-left.

Following flow regulation, the weirs inside of the Sodom Dam fishway on river-left would be removed using a tracked excavator fitted with a hydraulic pick working from the river-left bank. Removing the weirs would drawdown the upstream reservoir elevation and reduce the static water pressure on the upstream side of the dam. The removed concrete would then be loaded to dump trucks for hauling. The dump trucks will access river-left by way of the existing low water crossing downstream of Sodom Dam or by way of the cofferdam crossing downstream from the bifurcation.

Depending on the resulting reservoir water surface elevation, a bulk bag cofferdam would be built from river-right to river-left immediately upstream of Sodom Dam. The cofferdam would route the streamflow into the fishway to provide fish passage and a clear water bypass during the dam removal. Figure 4-3 and 4-4 include ground photos of Sodom Dam.



Figure 4-3. An upstream view of Sodom Dam showing the river-right abutment, dam face, the portioning wall between the dam face and river-left fishway, and the river-left fishway.



Figure 4-4. The river-right abutment that will be lowered to provide access to the dam apron will also be removed as part of the project (left). The fishway on river-left will be used for fish passage and clear water bypass during dam deconstruction (right). The fishway and river-left abutment will also be removed.

Bulk bags will be used for constructing the cofferdam immediately upstream of Sodom Dam. Bulk bags are flexible and conform to the irregular shape of the river bottom to seal out water and fish from the isolated area (Figure 4-5). Each bulk bag is self-contained so there is negligible risk of catastrophic failure of the cofferdam should an individual bulk bag fail. One tier of fifteen 6 ft x 6 ft x 4 ft bulk bags will be necessary to divert flow through the fishway. In addition, a floating silt curtain will be suspended downstream of the dam to control sediment that may be washed downstream of the work area. Silt curtains are impermeable barriers constructed of a flexible reinforced thermoplastic or geotextile with a floatation material on the top and a ballast material on the bottom. Silt curtains can effectively control sediment-laden waters and reduce downstream sedimentation related to in-stream project activities.



Figure 4-5. Example of stacked bulk bags used to isolate a work area on the Rogue River at the Savage Rapids Dam Removal project (left). A bulk bag being moved into place as part of the Gold Hill Dam Removal project (right).

A screened 6 inch pump will be available for pumping turbid water from the isolation area. Pumped water will be discharged to the adjacent terrace and contained so that turbid water will not reenter Sodom Ditch or the Calapooia River. Fish salvage efforts will be completed in the gap between the cofferdam and the top of Sodom Dam and the turbidity curtain and the downstream extent of Sodom Dam.

Once the work area isolation devices are established, the dam apron will be accessed. The river-right concrete abutment will be lowered to 1-2 ft above the dam's crest elevation. A rock ramp will be built from the lowered river-right abutment down to the concrete apron downstream of the dam face to provide equipment access to the dam. Concrete will be removed using a tracked excavator fitted with a hydraulic pick and a second excavator with a standard thumb and bucket. The hydraulic pick will be used to break up the concrete which will be loaded by the second excavator to 10-wheel dump trucks that will access the concrete apron via the rock ramp. Trucks may also be loaded on the right terrace to minimize traffic on the apron. After the dam spillway is removed, the apron removal will follow.

Removed concrete would be processed by breaking into 3 ft x 3 ft or smaller chunks. Metal or other debris exposed on the concrete surface will be removed. The broken concrete will be hauled to the Upper Millrace channel upstream from Shearer Dam where it would be placed to form the base for the Upper Millrace fill plug. The Upper Millrace fill plug is further described in section 4.3.2 *Phase 2: Shearer Dam Removal and Upper Millrace Filling*.

Once the dam is removed to the fishway, the turbidity curtain located downstream of the former dam and the bulk bag cofferdam will be incrementally removed beginning on river-right to allow flow to access the right side of the channel. Boulders will be placed in the bypass channel to provide velocity breaks to ensure fish passage through the former dam site. As the stream will occupy a lower elevation through the re-graded former river-right dam site, the fishway and river-left abutment will be removed under primarily dry conditions. However, turbidity mitigation equipment will be deployed to maintain turbid water within the work area. The fishway and river-left abutment material will be out-hauled by using either the low water crossing at the downstream extent of the project area, or via the cofferdam crossing located downstream from the Calapooia River-Sodom Ditch bifurcation.

4.3.2 Phase 2: Shearer Dam Removal and Upper Millrace Filling

The removal of Shearer Dam will be completed in a similar fashion as the removal of Sodom Dam. A bulk bag cofferdam will be built from river-left towards river-right. The existing fishway on river-left will be maintained for fish passage and clear water diversion. Due to archaeological resources on the river-right floodplain, equipment access and material transport will be completed solely from river-left.

Due to poor site access, round 12 inch minus rock will be imported to the site to provide the excavator with a pad to work from for removing the 35 ft wide dam. The pad will be placed immediately upstream of the dam on the river-left side of the channel and extend towards river-right. A 36 inch culvert will be used to pass flows. The culvert will have the capacity to convey flows exceeding the 50 cfs maximum discharge expected during the work window. A floating turbidity curtain will be installed downstream of the dam to isolate the work area from clean water. The curtain will be connected to the outlet of the fishway on river-left and the streambank on river-right. A fish salvage effort will be completed to remove fish from the isolated areas both upstream and downstream of Shearer Dam.

As the concrete dam is removed from the channel, it will be loaded to trucks for treatment and placement in the Upper Millrace to form the base of the fill plug. The work pad material will be used to provide a coarse surface material for the Calapooia River through the dam site after Shearer Dam is removed.

Once the main portion of the dam is removed, the turbidity curtain and the bulk bag cofferdam will be removed from river-right to river-left. The river-left fishway will be removed from the river-left bank. A bulk bag cofferdam will be located from upstream to downstream of the fishway to isolate the work area. Fish will be salvaged from the isolated work area prior to the fishway being removed. Round rock from the construction pad and other material will be imported to provide a coarse channel bed through the former dam site. Large wood habitat structures will span the length of the former dam's footprint on either side of the channel to provide habitat and streambank stability.

The Upper Millrace will be filled starting at the inlet from the Calapooia River. Floating turbidity curtains will be set at the inlet and downstream extent of the active filling area in the Upper Millrace. The downstream curtain will be moved in a downstream direction as the fill plug length expands. The proposed action includes filling the Upper Millrace to confine flows up to the bankfull discharge to the Calapooia River channel. Disconnecting the Upper Millrace from the Calapooia River will also reduce the potential for flood debris impacting Thompson's Mills as well as diverting fish through the Mills' infrastructure. Flows exceeding the bankfull elevation will access the plug surface and surrounding floodplain. The fill plug will consist of three layers. The base layer (1-2 ft deep) will include broken and cleaned concrete hauled from Sodom Dam and Shearer Dam. The foundation material will mainly be located towards the upstream extent of the fill plug. This material will provide a sound foundation for the fill plug at the interface with the Calapooia River. The second layer (2-3 ft) will include fill material excavated from the Sodom Ditch. Top soil (1 ft) will comprise the top layer of the fill plug. Salvaged shrub clump transplants, containerized plants, and willow cuttings will be planted on the plug surface. Large wood habitat structures will be built on the plug face to stabilize the plug face and enhance aquatic habitat in the Calapooia River.

Filling the entire Upper Millrace will require approximately 4,000 cy of material which would come from the Sodom Ditch reconstruction (10 mile haul distance round trip). Filling the connector ditch will be one

means for disposing of clean excavated material near the Sodom Ditch project area. The excavation volume will exceed the connector ditch fill capacity, therefore requiring additional disposal areas.

4.3.3 Phase 3: Sodom Ditch Reconstruction

Phase 3 will include rebuilding Sodom Ditch from the Calapooia River-Sodom Ditch bifurcation, downstream to below the existing Sodom Dam location. Channel reconstruction is necessary to provide fish passage, ensure channel stability, and maintain flow partitioning between the Calapooia River and Sodom Ditch. Channel reconstruction will include building three engineered riffles and three pools in the 1,500 project reach. Engineered riffles, large wood habitat structures, and site revegetation plan will be implemented.

The Sodom Ditch reconstruction design included determining how stream flow is partitioned between the Calapooia River and Sodom Ditch under existing conditions. Discharge data were collected upstream of the Calapooia River – Sodom Ditch bifurcation, on the Calapooia River downstream of the bifurcation, and on Sodom Ditch downstream from the bifurcation. Field data suggested that the Sodom Ditch captures greater than 80% of the discharge at the bifurcation. These results were used as guidance for the existing condition 1-dimensional hydraulic modeling completed in HEC-RAS. Since one of the project goals is to maintain the approximate high flow discharge partitioning between the Calapooia River and Sodom Ditch, the predicted bankfull (1.5 year) discharge for the Sodom Ditch was used as the design discharge for developing the Sodom Ditch channel dimensions based on the Sodom Ditch capturing approximately 75% of the stream flow at the bifurcation.

A bankfull slope of 0.0101 ft/ft was used for the design slope. Riffle and pool channel habitat unit templates were created to convey the predicted bankfull discharge. Channel bed material and habitat structures were designed to withstand the 10 year discharge event. Flows greater than the 10 year discharge are contained within the entrenched channel.

Trees will be imported to build large wood habitat structures throughout the Sodom Ditch project area. Habitat structures will be built to provide lateral channel stability and enhance aquatic habitat. Coarse cobble and boulders will be imported to build engineered riffles. Engineered riffles will provide grade control, maintain upstream pools, and diversify aquatic habitat. Salvaged vegetation, containerized plants, and willow cuttings will be planted in the river corridor for riparian enhancement and channel stability.

A 24 inch HDPE pipe will be used to dewater the project reach during construction. The pipe will be located on the river-left side of the channel. The pipe will connect to the 24 inch culvert installed in the upstream cofferdam located downstream from the bifurcation, and will outlet downstream of Sodom Dam. This will enable construction to be completed in relatively dry conditions. Downstream fish passage will be maintained via the HDPE pipe. However, due to the pipe length and in-pipe water velocities, upstream fish passage will not be maintained during the one month channel reconstruction period.

4.3.4 Phase 4: Calapooia River Reconstruction

Phase 4 will include installing large wood structures upstream from and at the inlet to the Calapooia River channel at the Calapooia River-Sodom Ditch bifurcation. Large wood habitat structures and an engineered channel bed in the Calapooia River inlet will be built to provide a more stable transition into Calapooia River channel through the bifurcation. The intent of the structures will be to control the

amount of flow into the Calapooia River channel, maintain channel depths, influence large wood capture, and provide aquatic habitat.

The Calapooia River inlet work area will be accessed via the cofferdam located immediately downstream from the bifurcation. Materials and equipment will be transported across the cofferdam crossing and staged adjacent to the work area on the agricultural field. A ramp will be built from the agricultural field to the channel to enable equipment to move materials and complete the construction work at the Calapooia River inlet. Construction work will include integrating existing large wood with imported large wood to build the habitat structures. The existing inset reed canarygrass ground surface will be built up with wood and gravels to create a bench at the design bankfull elevation. This action will improve the flow partitioning at the bifurcation.

Coarse cobble will be used to build the cobble patch at the inlet to the Calapooia River channel. In conjunction with the Sodom Ditch channel design, the cobble patch for the Calapooia River inlet will be set to promote a 50-50 split of low flows at the bifurcation.

A second large wood habitat structure will be built on river-right of the Calapooia River inlet where the access ramp is located. Similar to the upstream large wood structure, this structure will be installed for streambank protection and aquatic habitat enhancement.

4.3.5 Dam Removal and Channel Reconstruction Equipment

The removal of Sodom and Shearer dams and the reconstruction of the Sodom Ditch and Calapooia River through the action areas will be completed using standard, heavy civil-works type equipment. Table 4-1 includes the expected equipment for the project. Additional equipment may be provided by the contractor if deemed necessary. The contractor will have adequate supplies of floating silt curtains, bulk bags for temporary cofferdams, silt fences for erosion control, and emergency cleanup spill kits. No hazardous material will be used or stored on the project sites.

Table 4-1. Equipment necessary for the removal of Sodom Dam and Shearer Dam, and channel reconstruction.	
Quantity	Equipment Description
2	Track hoe, Komatsu 220 or similar with bucket and thumb extension
1	Track hoe, Komatsu 220 or similar with hydraulic breaker
1	Off-road dump truck, rubber tires, 15 cubic yard capacity
1	Wheeled frontend loader, CAT 928 or similar with bucket and forks
1	Caterpillar D6 bulldozer, track-mounted
4	Dump truck, 10 cubic yard capacity, street capable
1	6" diesel pump with screen for dewatering
1	3" trash pumps with 150 ft of 2 inch fire hose and nozzle

5 SPECIES ACCOUNTS AND CRITICAL HABITAT

5.1 Species Within the Action Area

Based on the review of the Oregon Natural Heritage Information Center (ORNHIC) in July 2010, five threatened or endangered species may occur within 2 miles of the Sodom Dam and Shearer Dam project area (Table 5-1). Of the species listed in Table 5-1, only Upper Willamette River (UWR) spring Chinook salmon and UWR winter steelhead would be potentially affected by the project.

Table 5-1. Threatened and endangered species that may occur within two miles of Sodom Dam and Shearer Dam (ORNHIC 2010).

Species Name	Federal Listing	Project Impact
Golden paintbrush <i>Castilleja levisecta</i>	Threatened	Not likely to affect due to limited project area and uncommon occurrence of plant. Last observation in 1922.
Bradshaw's desert parsley <i>Lomatium bradshawii</i>	Endangered	Not likely to affect due to limited project area and uncommon occurrence of plant. Population's specific location unknown within the Brownsville quad map.
Nelson's checkermallow <i>Sidalcea nelsoniana</i>	Threatened	Not likely to affect due to location of population relative to the action area.
UWR spring Chinook salmon <i>Oncorhynchus tshawytscha</i>	Threatened	May affect, not likely to adversely affect due to construction timing coinciding with species avoidance of action area due to water temperature limitations. Long-term benefit with removal of dams.
UWR winter steelhead <i>Oncorhynchus mykiss</i>	Threatened	May affect, not likely to adversely affect due to construction timing coinciding with species avoidance of action area due to water temperature limitations. Long-term benefit with removal of dams.

5.2 Terrestrial Species

Three terrestrial species listed as threatened or endangered were identified as potentially being within two miles of the project sites based on the ORNHIC database review. Ms. Kate Norman, USFWS Botanist, field reviewed the Sodom Dam and Shearer Dam project areas on May 17, 2010. Ms. Norman concluded that no listed terrestrial species were found nor were there any indications of suitable habitat. Furthermore, the areas which might be impacted by changes in hydrology appear to have similar vegetation to the sites which were closely examined. That is, these areas are heavily invaded by blackberry, dense reed canarygrass, rose, and woody species. Of the three listed plant species historically found in this area of the Willamette Valley, Nelson's checkermallow is the most tolerant to weedy conditions. Although Nelson's checkermallow can occasionally be found in areas with less than

pristine habitat, the level of weed species invasion found at this site would likely preclude even Nelson's checkermallow from establishing or surviving.

Based upon examinations of the habitat near the dam areas and several points along the channels, it is Ms. Norman's opinion that no listed terrestrial species are located in the project areas, therefore, no listed plants would be affected by the projects as proposed.

5.3 Upper Willamette River Spring Chinook Salmon

The following information for Upper Willamette River (UWR) spring Chinook and UWR steelhead is taken largely from the *Biological Assessment – Columbia River Channel Operations and Maintenance* (USACE 2004), the *Supplemental Biological Assessment of the Effects of the Willamette River Basin Flood Control Project on Species listed Under the Endangered Species Act* (USACE 2007), and the *Willamette Project Biological Opinion* (NMFS 2008).

5.3.1 Status

UWR Chinook salmon evolutionary significant unit (ESU) includes all naturally spawned populations of spring-run Chinook salmon in the Clackamas River and in the Willamette River, and its tributaries, above Willamette Falls, Oregon (NMFS 2005a). NMFS listed UWR Chinook salmon as threatened under the ESA on March 24, 1999 (64 FR 14308); the threatened status was reaffirmed June 28, 2005 (70 FR 37160). Critical habitat was designated on September 2, 2005 (70 FR 52630).

5.3.2 ESU Description

The Willamette/Lower Columbia Technical Recovery Team (W/LC TRT) identified seven independent populations within this ESU: Clackamas River, Molalla River, North Fork Santiam River, South Fork Santiam River, Calapooia River, McKenzie River, and Middle Fork Willamette River (Myers and others, 2006). Of these, the W/LC TRT designated the Clackamas River, North Santiam River, McKenzie River, and Middle Fork Willamette River populations as core populations. Core populations are defined as those populations which are believed to have been the most productive historically. The W/LC TRT also designated the McKenzie River population as a genetic legacy population, which is a population having minimal hatchery influence or exhibiting important life-history characteristics no longer found throughout the ESU (McElhany and others 2003). McElhany and others (2003) recommended that core and legacy populations be given priority in recovery planning because these populations may have the intrinsic capacity to sustain large populations into the future and they retain the most intact representation of the genetic character of the ESU.

Seven artificial propagation programs are considered to be part of the ESU: McKenzie River Hatchery (stock # 24), Marion Forks/North Fork Santiam River (stock # 21), South Santiam Hatchery (stock # 23) in the South Fork Santiam River, South Santiam Hatchery (stock # 23) in the Calapooia River, South Santiam Hatchery (stock # 23) in the Molalla River, Willamette Hatchery (stock # 22), and Clackamas Hatchery (stock # 19) spring-run Chinook programs (NMFS 2005a).

According to the W/LC TRT, none of the seven independent populations were considered viable (McElhany and others 2004). For the evaluation, populations were ranked for extinction risk on a scale of 0 to 4, with 0 meaning extinct or at a very high risk of extinction and 4 meaning a very low extinction risk in 100 years.

To estimate population extinction risk, the W/LC TRT evaluated four key attributes: abundance and productivity, diversity, spatial structure, and habitat. A fifth population attribute, juvenile out-migrant growth rate, was part of the W/LC TRT viability criteria, but did not have much impact on the population evaluations due to lack of data. The four main population attributes were evaluated on the same 0–4 risk scale. To obtain the overall population score, individual population attribute scores were integrated using a simple weighted mean; the abundance and productivity scores were weighted at twice the other scores (McElhany, et al. 2007). Abundance and productivity are given greater weight than other attributes because they are considered to be clearer predictors of extinction risk than the other population attributes. A Viability Score of 0.65 was given to the Calapooia River population, the third lowest score of the seven populations in the Upper Willamette River. The Molalla River (0.62) and the Middle Fork Willamette River (0.64) scored lower.

5.3.3 Distribution and Critical Habitat

Historically the Upper Willamette supported large numbers (perhaps exceeding 275,000 fish) of Chinook salmon (Myers and others 2006). While counts of hatchery- and natural-origin adult spring Chinook salmon over Willamette Falls since 1946 have increased, approximately 90 percent of the return is now hatchery fish. Current abundance of wild fish is estimated to be less than 10,000, with significant natural production occurring only in two populations – the Clackamas River and the McKenzie River (McElhany and others 2007). The Clackamas and McKenzie are the only two watersheds in the ESU where sufficient habitat is still accessible and of sufficient quality to produce significant numbers of natural-origin spring Chinook.

A population of spring Chinook salmon historically existed in the Calapooia River. Parkhurst and others (1950) estimated suitable habitat for 9,000 fish, although Willis and others (1960) estimated the run at only 100–500 fish. Parkhurst and others (1950) reported the 1941 run was approximately 200 adults, Mattson (1948) estimated the run at 30 in 1947. Nicholas (1995) considered the run extinct, with limited future production potential. Approximately 546,710 hatchery juvenile Chinook salmon from the Santiam River Hatchery and the Willamette Hatchery were released in the Calapooia River from 1981 through 1985 (USACE 2006).

The mainstem Calapooia River is designated critical habitat for UWR Chinook salmon (NMFS 2005). NMFS has designated critical habitat for 12 of the 13 salmon and steelhead species (NMFS 2008). The primary constituent elements essential for conserving the species, including UWR Chinook salmon and UWR steelhead, are those sites and habitat components that support one or more life stages, including:

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.
- Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
- Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival

- Estuarine areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
- Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Major limiting factors that have affected UWR Chinook salmon include the following.

- Reduced access to spawning/rearing habitat
- Degraded water quality
- High water temperature
- Lost/degraded floodplain connectivity and lowland stream habitat
- Reduced streamflow

5.3.4 Life History and Ecology

While adult UWR Chinook salmon begin appearing in the lower Willamette River in January, the majority of the run ascends the falls in April through May (Myers and others 2006). Mattson (1963) discusses the existence of a late spring-run Chinook salmon that ascended the falls in June. These fish were apparently much larger and older (presumably 6 year olds) than the earlier part of the run. Mattson (1963) speculated that this portion of the run intermingled with the earlier-run fish on the spawning grounds and did not represent a distinct run. The disappearance of the June run in the Willamette River in the 1920s and 1930s was associated with a dramatic decline in water quality in the lower Willamette River.

The UWR Chinook salmon ESU exhibits one life history type. As cited in Myers and others (2006), Chinook salmon native to the upper Willamette River are considered to be ocean-type. Ocean-type salmon out-migrate to the ocean during their first year and tend to migrate north along the coast. Marine recoveries of CWT-marked UWR Chinook occur off the British Columbia and Alaska coasts (Myers and others 2006). UWR Chinook mature during their fourth and fifth years.

5.3.5 Adult Chinook Salmon

At present, adults return to the Willamette River primarily at ages 3 through 5 (ODFW 2008c), with age 4 fish being most abundant. Historically, age 5 fish were most abundant, and spawning occurred between mid-July and late October. The current spawn timing of both hatchery and natural-origin UWR Chinook is September and early October (Schroeder and Kenaston 2004). Additional adult Chinook salmon habitat requirements and life history information is presented in NMFS (2005).

Spring Chinook enter the Calapooia River watershed in late April and May with the migration continuing into July. Spawning takes place between September and mid-November. Before spawning, adult spring Chinook hold in pools, preferring deep pools with cool water, abundant large wood, and undercut banks for cover. All spring Chinook spawning takes place in the river channel and tributary streams above Holley. Spring Chinook salmon die after spawning, providing a marine-derived nutrient source to the Calapooia River.

5.3.6 Juvenile Chinook Salmon

Juvenile emigration patterns of the UWR Chinook salmon include traits from both ocean- and stream-type life histories. Smolt emigrations occur both as subyearlings, consistent with ocean-type life histories, and as yearlings, consistent with stream-type life histories, in the fall and spring (Schroeder and Kenaston 2004). Additional juvenile Chinook salmon habitat requirements and life history information is presented in NMFS (2005).

Juveniles can spend up to a year rearing in the Calapooia River. Like other salmonids, juvenile spring Chinook require cold water (less than 64 °F), high dissolved oxygen concentrations, and deep pools for feeding and cover from predators. Access to tributary streams to find refuge from high flows in the winter is also important.

5.4 Upper Willamette River Winter Steelhead

5.4.1 Status

NMFS listed Upper Willamette River steelhead as threatened under the ESA on March 25, 1999 (64 FR 14517); the threatened status was reaffirmed on January 5, 2006 (71 FR 834). Critical habitat was designated on September 2, 2005 (70 FR 52630).

5.4.2 DPS Description

The UWR steelhead distinct population segment (DPS) includes all naturally spawned anadromous winter-run steelhead populations in the Willamette River and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive). There are no hatchery programs included in this ESU (NMFS 2006b). The hatchery summer-run steelhead that occur in the Willamette Basin are an out-of-basin stock and not considered part of the DPS.

The W/LC TRT identified four independent populations within this DPS: Molalla River, North Fork Santiam River, South Fork Santiam River, and Calapooia River (Myers and others 2006). Although spawning winter steelhead have been reported in the west-side tributaries to the Willamette River, these tributaries are not considered to have historically constituted a distinct independent population (Myers and others 2006). However, these tributaries may serve as a population sink for this DPS, where fish spawning in these areas do not produce appreciable numbers of offspring due to habitat conditions. Of these populations, the W/LC TRT designated the North Fork Santiam River and South Fork Santiam River as core populations (McElhany and others 2003). Core populations historically represented substantial portions of the DPS's abundance or contained life-histories specific to the DPS. In addition, due to their genetic integrity, the W/LC TRT also designated the North Fork Santiam River and South Fork Santiam River as genetic legacy populations (McElhany and others 2003).

According to the W/LC TRT, none of the four UWR River steelhead independent populations were considered viable (McElhany and others 2004). A Viability Score of 1.48 was given to the Calapooia River population, tied for the highest score of the four populations in the Upper Willamette River.

5.4.3 Distribution and Critical Habitat

Howell and others (1985) reported that the relative distribution of steelhead spawning in the upper Willamette River during the 1960s was 8% in the Calapooia River, 57% in the Santiam River, and 35% in the Molalla River. Allocating the estimated escapement using this proportion yields 77,000 in the

Molalla River, 125,400 in the Santiam River (with approximately 75,240 and 50,160 in the North and South Santiam rivers, respectively, based on a 60:40 split), and 17,600 in the Calapooia River.

Genetic analysis indicates a close affinity between winter steelhead populations in the Santiam, Molalla, and Calapooia rivers. Steelhead descended from summer- (Skamania) and early winter-run (Big Creek) hatchery populations are distinct from the native steelhead (NMFS 1997). Late winter steelhead are native to the Calapooia River. Parkhurst and others (1950) reported that steelhead ascended the Calapooia River as far as 87 km upstream, although passage at the Finley Mill Dam (RKM 42) may not have been possible during low flow periods. A survey conducted in 1958 from the town of Holley, Oregon, to the mouth of Potts Creek (31.7 km) recorded 73 steelhead adults (live and dead) and 427 redds (Willis and others 1960). There is no hatchery program on the Calapooia River. Chilcote (1998) estimated that contribution of hatchery fish to escapement (strays from other upper Willamette River releases) is less than 5%. This population has declined to very low levels since the late 1980s.

Numbers of steelhead in this DPS are depressed from historical levels, but to a much lesser extent than spring Chinook in the Willamette basin (McElhany and others 2007). Estimates for natural spawners in the Calapooia River ranged from 206 to 560 with a geometric mean of 339 spawners from 1990 to 2005 (McElhany and others 2007). Spawning fish were not of hatchery origin and nearly 99% of adult fish that returned to the Calapooia River were spawners (McElhany and others 2007). On average, 1.126 recruits were contributed by each spawning fish.

The Calapooia River is designated critical habitat for UWR steelhead. Listed tributaries with critical habitat within the Upper Calapooia watershed (upstream from approximately the Butte Creek confluence) include Biggs Creek, Butte Creek, Hands Creek, King Creek, McKinley Creek, North Fork Calapooia River, Potts Creek, Spoon Creek, and United States Creek.

NMFS has designated critical habitat for 12 of the 13 salmon and steelhead species (NMFS 2008). The primary constituent elements and limiting habitat factors for UWR steelhead were previously provided for UWR spring Chinook salmon.

5.4.4 Life History and Ecology

The native steelhead of the UWR basin are late-migrating winter steelhead, entering fresh water beginning in January and February but do not ascend to spawning areas until late March or April. Spawning takes place from April to June 1 (Myers and others 2006). This unusual run timing appears to be an adaptation for ascending Willamette Falls, which function as an isolating mechanism for upper Willamette River steelhead (Busby and others 1996). Early migrating winter steelhead and summer steelhead have been introduced to the Upper Willamette River Basin; however, these non-native populations are not components of this ESU. Native winter steelhead within this ESU have been declining on average since 1971 and have exhibited large fluctuations in abundance.

5.4.5 Adult Steelhead

Steelhead most commonly spend 2 years (2-ocean) in the ocean before entering fresh water to spawn. Populations in Oregon and California have higher frequencies of age-1-ocean steelhead than populations to the north, but age-2-ocean steelhead generally remains dominant. Additional adult steelhead habitat requirements and life history information is presented in NMFS (2005).

Returning adults enter the Calapooia River between December and April, with peak spawning in May. Spawning occurs in low/moderate gradient streams (up to 8%). Most of the winter steelhead spawning takes place in the river channel and tributary streams above Holley.

5.4.6 Juvenile Steelhead

Juvenile steelhead spend from 1 to 7 years (average 2 years) in fresh water and outmigrate to the ocean during spring and early summer. Juveniles rear in the upper river and smaller tributaries for as long as 4 years in fresh water; prefer pools with cover, large wood, and cool water temperatures (less than 64 °F), and high dissolved oxygen levels. Additional juvenile steelhead habitat requirements and life history information is presented in NMFS (2005).

6 ENVIRONMENTAL BASELINE

The environmental baseline describes the impacts of past and ongoing human and natural factors leading to the present status of the species and its habitat within the action area. The environmental baseline provides a “snapshot” of the relevant species’ health at a specified point in time. The environmental baseline includes past and present impacts from all federal, state, private, and other human activities in the action area.

6.1 Water Quality

Water quality in the Calapooia River mainstem and in its tributaries has been degraded by historical and current land uses. Under Section 303(d) of the Federal Clean Water Act (CWA), the Oregon Department of Environmental Quality (ODEQ) prepared a list of stream segments that do not meet water quality standards, referred to as the “303(d) list.” The mainstem Calapooia River within the action area does not meet water quality standards for the following based on data collected in 2004. Table 6-1 includes the river mile, water quality parameter, beneficial use affected, and the water quality limiting status. Water quality parameters that are most important to anadromous salmonids include water temperature, dissolved oxygen, and flows.

Table 6-1. Water quality parameters that are not meeting beneficial use criteria in the Calapooia River from the mouth of the river to RM 78. The Sodom Dam is located at RM 28 (ODEQ 2010).

River Miles	Parameter	BeneficialUses	Status
0 to 42.8	Fecal Coliform	Water contact recreation	303(d)
0 to 78	Ammonia	Aquatic life	Category 2
0 to 42.8	Chlorophyll a	Aesthetics	Category 2
0 to 35.7	Dissolved Oxygen	Cool-water aquatic life	Category 2
0 to 42.8	E Coli	Water contact recreation	Category 2
0 to 42.8	pH	Anadromous fish passage	Category 2
0 to 42.8	pH	Anadromous fish passage	Category 2
0.1 to 31.2	Dissolved Oxygen	Resident trout spawning	Category 5
0 to 42.8	E Coli	Water contact recreation	Category 5
0 to 78	Iron	Aquatic life	Category 5
0 to 42.8	Manganese	Human health	Category 5
0 to 35.7	Temperature	Salmon and trout rearing and migration	Category 5
0 to 42.8	Flow Modification	Resident fish and aquatic life	Water quality limited
Cat 2: Attaining some criteria/uses			
Cat 5: Water quality limited, 303(d) list, TMDL needed			

Water temperatures recently measured throughout the watershed are probably similar to natural patterns, except along some tributaries (CWC 2004). The mainstem Calapooia River is wide throughout much of its length, and even if mature conifers and hardwoods again grew along the banks, the trees would still not provide much shade to the summer channel. Rapid regrowth of trees along those upper watershed forest streams that were once harvested of trees, combined with current regulations for retaining wide buffers of trees during timber harvest, means that shading levels are high on forest land. Shade is sparser along streams in agricultural and urban areas, and is most critical to providing cool water refuge for fish during the summer months.

6.2 Habitat Access

Dams and road crossing culverts are examples of potential fish passage barriers that are present in the watershed. Fish move through the river channel and tributary streams through phases of their life cycle and in response to changing conditions. When there is a barrier to fish passage fish cannot access important areas for spawning or move into cool tributary streams when the Calapooia River or other streams warm during the summer months. Fish passage barriers can totally block fish movement during all times or they can partially block movement for periods associated with high or low stream flows. Partial fish passage barriers can significantly slow the migration of spring Chinook salmon and winter steelhead through the river. Fish will often hold in pools at the base of a barrier waiting for conditions to change, creating problems such as stress on the fish, delaying migration, providing opportunities for poaching and predation.

Sodom Dam and Shearer Dam inhibit free passage for migrating fish and temporally block access to upstream habitat. Planning for removal of the two dams follows the earlier removal of Brownsville Dam that was completed in 2007. Sodom Dam and Shearer Dam present the last two substantial migration barriers on the Calapooia River. Information on the Brownsville Dam Removal Project is provided from the Calapooia Watershed Council website (<http://www.calapooia.org/projects/brownsville-dam-removal/>):

After years of public discussion, the Brownsville community stakeholders made the unanimous decision on January 11, 2006 to support removal of the Brownsville Dam with the caveat that water be maintained in the small, historic canal that runs through the City of Brownsville (2.5 cfs). The dam provided no commerce, flood control, or community water supply. The dam's sole purpose was to divert water into the three-mile long Brownsville Canal. Once Sodom Dam, the last major fish passage barrier 8 miles downstream is removed, the Calapooia River will once again be a free flowing river and complete access to over 60 miles of mainstem habitat and several tributary streams will be restored. The successful dam [Brownsville Dam] removal, completed in September 2007, significantly improved access to the mainstem and tributary headwaters habitat on the Calapooia to winter steelhead and spring Chinook, both listed as threatened under the federal Endangered Species Act, and to cutthroat trout and Pacific lamprey. In November 2008 the Council completed the installation of a pump system at the former dam site to deliver water to the City of Brownsville and Canal Company members.

With the removal of Brownsville Dam complete, migrating fish continue to encounter significant passage problems due to Sodom Dam and Shearer Dam. These two structures are part of a complex of dams and diversion ditches associated with Thompson's Mills. Historically, water was diverted through the Mills for producing flour and, more recently, generating electricity. A series of dams and ditches (Sodom Ditch

and Thompson's Mills Millrace), divert the Calapooia River's flow, which creates problems for migrating fish. During late winter and early spring high flows, more of the river's water passes through Sodom Ditch and less water flows through the Calapooia River channel. Migrating winter steelhead move through Sodom Ditch and pass over the fishway at Sodom Dam. As flows drop in late spring the Mills needs more of the water to continue generating electricity [the mill, now owned by the State of Oregon, is no longer used to generate electricity]. The Mill operators [formerly] manage Sodom Dam to divert more of the river's flow into the Calapooia River channel. Late migrating spring Chinook salmon are delayed moving over the fishway at Sodom Dam. Water falling over the apron of the dam creates a "false attraction" to the base of the dam, delaying fish movement into the fishway.

Removal of the Sodom and Shearer dams will provide unimpeded upstream and downstream fish passage for resident and migratory species including federally threatened spring Chinook salmon and winter steelhead. The dams are located in the migratory corridor that is used by fish moving within the Calapooia River drainage but also between the Willamette River and the Calapooia River watershed.

6.3 Habitat Elements

Substrate within the project area is composed of gravel, sand, clay, and silt. Steelhead are known to currently spawn downstream of Sodom Dam although this behavior is believed to be due to delayed passage at the dam. With the dam removed, steelhead will likely migrate to the upper watershed to spawn. The prevalence of spring Chinook salmon spawning in the vicinity of Sodom and Shearer dams is unknown due to their low number in the Calapooia River watershed.

The Calapooia River supports a varied riparian vegetation community (Calapooia Watershed Council 2004). In more extensive floodplain areas, hardwood species consist of Oregon ash, black cottonwood, big leaf maple, and red alder. These trees usually occur in combination. Younger hardwood stands are prevalent in the Middle Calapooia River, but are relatively scarce in other reaches of the Calapooia River. The Middle Calapooia River also has a high percentage of area in gravel bars. Younger hardwoods, usually found situated between a gravel bar and the older hardwood stands, are probably a result of tree establishment in areas cleared of vegetation during a major flood.

Notes and maps from the original land surveys conducted in the 1850s indicate that the Calapooia River was bordered by a continuous corridor of trees. Because of repeated burning of the valley floor by Native Americans during the previous centuries, vegetation beyond this corridor of trees was mostly native prairie or oak savanna. An examination of natural and human features that currently occupy land within this historical corridor of trees indicates that the combined percentage of trees and water features is only about 50 percent of what it was in the 1850s.

About one-half of the land along the Calapooia River that supported trees in the 1850s has since been converted to grass seed fields and other development. Remaining patches of older trees are mostly in low-lying areas that are too wet for farming. Older stands of trees are most extensive downstream of Brownsville where the river meanders widely over a relatively flat floodplain. In this vicinity, natural ponds are abundant, a result of the river abandoning its old channel for new locations. Most of the ponds are bordered by older hardwood stands and few have been altered by farming or development.

Vegetation communities in the action area are characterized by riparian species and agricultural crops. Plant species inhabiting the riparian zone include Oregon ash, cottonwood, alder, willows, dogwood, Himalayan blackberry, and reed canarygrass among others. Agricultural crops that border the riparian zone include turf grass.

6.3.1 Channel Conditions and Dynamics

Sodom Ditch and the Calapooia River are low gradient gravel-bed streams that have a local reach slope of approximately 0.1% and 0.06%, respectively in the action area. The existing dams are run-of-the-river type structures that do not have mechanisms to control flows other than the installation of check boards to raise the local water surface elevation. The dams function similar to broad crested weirs. Water also flows down the fishway of each structure. The current fishways do not meet ODFW's criteria for fish passage at all flow levels due to jump height and velocity limitations.

6.3.2 Hydrology

Flows in the Calapooia River vary greatly throughout the year due to seasonal precipitation and summer use of water. The average monthly January flow in Albany is 55 times the average August monthly flow. Nearly 90 percent of the runoff occurs during the six wettest months (November through April). The magnitude of annual runoff also varies. Rain-on-snow flood events have been responsible for the largest floods of record. These events typically occur between December and February when warm storms rain on the snowpack.

Tetra Tech (2008) performed a hydraulic analysis for the Sodom Ditch Dam Conversion project in May, 2008. One of two primary goals of the hydraulic analysis and modeling effort was to develop an understanding of the hydraulic processes involved in the division of flow between Sodom Ditch and the Calapooia River downstream of the bifurcation. Specific objectives included defining the actual division of flows at the bifurcation and to produce a base hydraulic model that can be modified during subsequent design phases to simulate the response of the river system to various options and alternatives.

The flow analysis was performed based on the Guidelines for Determining Flood Flow Frequency, Bulletin #17B (USGS 1982). Data were obtained from two gage stations. Gage station 1417200 is located upstream of the study area near the town of Holley, and has a period of record from 1935 to 1990. The second station, 14173500, is located downstream of the study area near Albany. The station has a period of record from 1940 to 1981.

Tetra Tech conducted flood frequency analyses from the annual instantaneous peak flows for both gage stations. Flow rates were proportionally adjusted for the point entering the study area. Table 6-2 presents a summary of the calculated instantaneous peak flows at the gage stations and at the bifurcation point at the upstream end of the project area.

Table 6-1. Results of the log-Pearson Type III probability distribution for Gage 14173500, Gage 1417200, and the bifurcation point at the upstream end of the project area (Tetra Tech 2008).

Location	Drainage Area	Recurrence Interval (yrs) and Instantaneous Peak Flow (cfs)							
		1.01	2	5	10	25	50	100	500
Gage 14173500 (Downstream)	372.3	2,921	12,104	19,727	25,300	32,954	38,967	45,219	51,798
Gage 14172000 (Upstream)	101.2	1,904	5,488	7,915	9,552	11,644	13,214	14,787	16,387
Bifurcation	164.0	2,140	7,021	10,652	13,207	16,582	19,181	21,837	24,591

To calculate flows in both Sodom Ditch and the Calapooia River downstream of the bifurcation, a HEC-RAS model was developed to perform one-dimensional hydraulic modeling. Input parameters included the stream alignment, channel cross-sections derived from the topographic survey, roughness coefficients based on a variety of methods, calculated flow rates, and boundary conditions including average channel slope. Based on these input parameters and the established channel geometry, the percentage of flow entering Sodom Ditch and the Calapooia River downstream of the bifurcation was determined. Results are summarized in Table 6-3 including total flow and percent of total flow entering Sodom Ditch and the Calapooia River for select recurrence intervals. Results are based on modeled flow division for the existing dam without flashboards.

Table 6-2. Modeled flow division for the Calapooia River and Sodom Ditch at the bifurcation point based on existing dam without flashboards (Tetra Tech 2008).

Total Flow Entering (cfs)	Recurrence Interval (yrs)	Calapooia River		Sodom Ditch	
		Flow Rate (cfs)	Percent of Total	Flow Rate (cfs)	Percent of Total
25	<1	7.9	31.5	17.1	68.5
50	<1	12.8	25.5	37.3	74.5
100	<1	22.0	22.0	78.0	78.0
250	<1	53.7	21.5	196.3	78.5
500	<1	109.7	21.9	390.3	78.1
750	<1	167.0	22.3	583.0	17.7
1,000	<1	222.8	22.3	771.2	77.1
1,500	<1	331.6	22.1	1,158.4	77.2
2,140	1	457.7	21.4	1,644.3	77.8
7,020	2	1,576.0	22.5	5,444.0	77.6
10,650	5	2,666.4	25.0	7,983.6	75.0
13,210	10	3,450.7	26.1	9,759.3	73.9
16,580	25	4,455.2	26.9	12,124.8	73.1
19,180	50	5,227.0	27.3	13,953.0	72.7
21,840	100	6,004.6	27.5	15,835.4	72.5
24,590	200	6,811.3	27.7	17,778.7	72.3

Tetra Tech concluded that the flow split to Sodom Ditch was higher than previously assumed, ranging from 68 to 77 percent (Tetra Tech 2008). This condition was partially attributed to sediment aggradation and large wood accumulation in the Calapooia River immediately downstream of the bifurcation point. As flows at the bifurcation point recede, the percent of total flow entering the Calapooia River decreases and becomes largely dependent on the elevation of the channel bed and the effects of sediment deposition just downstream of the bifurcation.

In summary, the following conclusions regarding the split flow conditions were determined from the hydraulic analysis performed by Tetra Tech.

- The division of flow to Sodom Ditch from the bifurcation is significantly larger at higher flows, with a percentage in the range of 68 to 77 percent conveying into Sodom Ditch.
- Sediment deposition, large wood accumulation, and natural river processes result in highly dynamic hydraulic conditions at the bifurcation.

The State of Oregon has granted many water rights to landowners along the Calapooia River and its tributaries (CWC 2004). The amount of permitted water use far exceeds the natural summer low flow of the river. Nevertheless, the existence of a large and old (non-consumptive) water right at the Thompson's Mill site in the lower watershed, in combination with an agricultural industry currently devoted to growing non-irrigated grass seed, has meant that the river flow is not greatly influenced by the use of these water rights.

7 EFFECTS OF THE PROPOSED ACTION ON UWR SPRING CHINOOK SALMON AND UWR WINTER STEELHEAD

Sodom Dam and Shearer Dam have impaired upstream and downstream migration of spring Chinook and winter steelhead in the Calapooia River system at least since the early 1900s. The removal of both dams will provide long-term benefits for the species. However, activities to remove the dams and restore the migratory corridor may adversely affect adult and juvenile Chinook and steelhead in the short term. Actions that may impact Chinook and steelhead or their habitat and efforts to avoid or minimize these impacts are described in the following sections.

7.1 Construction Timing

Three construction timing goals have been established for the project. Goals include: 1) removing the dams and stabilizing the stream channels during the ODFW approved in-water work period (June 1 to October 15) for the Calapooia River; 2) when stream flow is at the annual low to minimize turbidity effects; and 3) when adult and juvenile Chinook salmon and steelhead are least likely to be in the action areas. Construction would be planned to start mid-July when stream flows diminish. Based on Chinook salmon and steelhead periodicity, we would not expect adult fish to be in the action area during this period. Juvenile fish could be in the action area although warming water temperatures associated with diminishing flows and increasing air temperature would result in degraded habitat quality. In-stream construction would be completed by October 15. A work window extension is not expected to be necessary.

Table 7-1 includes a schedule for removing the dams and reconstructing the stream channels. The schedule proposes removing the dams concurrently to ensure all work is completed within the in-water work window.

7.2 Direct Injury and Displacement

Construction of the cofferdams and removal of the dam structures will create noise, vibrations, and surface water disturbance that could displace fish that are present near the work area. In general, exposure to “high sound levels can damage the inner ear sensory cells, produce hearing loss, elicit stress responses, and alter the behavior of fishes” (Popper and others 2003). Hastings (2002) recommended the noise level thresholds of 180 peak decibels (dB_{peak}) for injury and 150 dB_{RMS} for behavior effects to protect salmon. These high sounds levels are typically associated with in-water pile driving or blasting that create peaks of intense noise dramatically above ambient noise levels. No pile driving is proposed for dam removal and machinery would operate outside the water on either the shoreline or temporary access roads. The excavators used to construct the cofferdams typically generate noise ranges between 85 and 88 adjusted decibels (dBA), according to the Federal Highway Administration (2008). Because the decibel scale is logarithmic, there is nearly a 100-fold difference between noise levels expected from the action and noise levels known to have generated adverse effects to fish species.

Temporary cofferdams would be constructed on the upstream side of both dams to divert river flow and isolate portions of the dams for equipment access during demolition. Cofferdams will be constructed upstream of both the Sodom and Shearer dams to allow equipment access and dam removal with limited disturbance. Then cofferdams would be constructed on the south side of the dams to divert river flow toward the western streambanks. The installation of these cofferdams may trap out-migrating smolts and delay mitigation timing and expose individual fish to unsuitable water conditions. To mitigate the likelihood of Chinook, steelhead, or other fish species entrapment, fish inadvertently trapped inside the cofferdams would be salvaged immediately after the cofferdams are installed. Fish salvage would be accomplished by electrofishing and would be supervised by an ODFW fish biologist following the methods described in the fish salvage plan (Appendix B). The low frequency of Chinook and steelhead in the Calapooia River, and more specifically, in the project reach during the in-water work period makes it unlikely that these species will be encountered during the project.

Fish handling would likely harm or harass individual Chinook and steelhead that are encountered. If these species are encountered, only juveniles are expected to be present in the project area. Adult fish are not expected to be encountered due to the timing of the project. While effective at capturing fish, electrofishing can cause lethal spinal injuries. Juvenile salmonids tend to exhibit substantially lower spinal injury rates than adult fish. Smaller fish intercept a smaller head-to-tail potential than larger fish (Sharber and Carothers 1988) and therefore, maybe subject to lower injury rates (Dalbey and others 1996). McMichael and others (1998) found a 5.1% injury rate for juvenile steelhead captured by electrofishing in the Yakima River subbasin while Ainslie and others (1998) reported injury rates of 15% for direct current applications on juvenile rainbow trout. Only a few recent studies have examined the long-term effects of electrofishing on salmonid survival and growth (Ainslie and others 1998; Dalbey and others 1996). Use of electrofishing for fish salvage would comply with NMFS electrofishing guidelines (NMFS 2000) which are expected to adequately minimize the levels of stress, mortality, and competitive effects related to electrofishing.

7.3 Suspended Sediment

The removal of Sodom Dam and Shearer Dam will restore the natural processes of sediment transport, which will have a long term benefit for aquatic habitat and fish. The Sodom Ditch upstream of Sodom Dam will be reconstructed following dam removal. The reconstruction will remove sediment that has accumulated upstream of the dam. No large pulse of sediment will occur once the dam is removed. An

elevated level of suspended sediment will be released with the first runoff event following the dam removal/channel reconstruction as finer particles are mobilized from the project. Turbidity levels are expected to return to upstream background levels following this initial event.

Removal of Shearer Dam is expected to result in greater vertical channel adjustment upstream of the former Shearer Dam site. Due to the flatter channel slope on the Calapooia River compared to Sodom Ditch, the dam removal will affect a longer reach of river channel. Fine sediment that has accumulated upstream of Shearer Dam will be mobilized as the river adjusts to a new base elevation. Eroded sediments will range from silts to medium gravels and are expected to be mobilized over time in response to annual flood events. Patchy sediment deposition is expected downstream of the former dam site as material deposition is influenced by particle sizes and discharge. The erosion rate of stored sediments will be predicated on runoff magnitude and frequency into the future.

This flushing of sediment downstream from Sodom Dam and Shearer Dam would expose Chinook and steelhead within the action area to increased levels of suspended sediments. Depending on the level of exposure, suspended sediment can cause lethal, sublethal, and behavioral effects in juvenile and adult salmonids (Newcombe and Jensen 1996). For salmonids, elevated suspended sediment (i.e., turbidity) has been linked to a number of behavioral and physiological responses (i.e., gill flaring, coughing, avoidance, and increase in blood sugar levels) which indicate some level of stress (Bisson and Bilby 1982; Sigler and others 1984; Berg and Northcote 1985; Servizi and Martens 1992). Most of these studies observed chronic turbidity levels rather than the brief spikes that are likely under the proposed action. Although turbidity may cause stress, Gregory and Northcote (1993) have shown that moderate levels of turbidity (35 to 150 nephelometric turbidity units [NTUs]) accelerate foraging rates among juvenile Chinook salmon, likely because of reduced vulnerability to predators (camouflaging effect). The effects will be most acute directly below the dam and would decrease with distance downstream as suspended sediment settles out of the water column. The elevated sediment periods will also coincide with naturally high transport rates associated with runoff events.

Short term increases in sedimentation will occur during the initial dam removal phase, and increased sedimentation will occur during high water flows. Because the sediments stored behind the dams are essentially the same as sediments existing in the river channel below the dams, and are not contaminated by mine wastes or pesticides, no substantial degradation of habitat or water quality on the Calapooia River or Sodom Ditch is expected.

7.4 Fish Passage During Dam Removal

Fish passage at Sodom Dam and Shearer Dam is currently limited by substandard fish passage facilities. During the initial phase of the dam removals, the existing fishways will be utilized for upstream fish passage from mid-July to early August. The following sections present the plan for ensuring fish passage during the dam removals.

7.4.1 Fish Passage During Sodom Dam Removal

The height of Sodom Dam precludes fish passage over the dam during nearly all flows, and the substandard fishway (Figure 7-1) on the west side of the dam is believed to further limit fish passage past the dam site. The cofferdam constructed upstream of the dam will divert water through the existing fishway. The fishway will be cleaned of debris as necessary during the diversion period. Since flows in Sodom Ditch are not expected to exceed 50 cfs during the project period, the volume of water diverted through the ladder will be less than the minimum flow that ODFW recommends for passage

during the spring migration period. Therefore, flows through the fishway are not expected to create adverse conditions for fish moving through the ladder.



Figure 7-1. The Sodom Dam fishway. The left photo shows the ladder when the upstream inlet is plugged with debris. The river photo shows the ladder under operational conditions. Photos courtesy Crispin (2010).

Once Sodom Dam is removed, the cofferdam will be removed from the river-right streambank. The river flow will assume this location as it will be the lowest channel elevation. Boulders will be placed in the channel to provide fish resting areas through the transition area from upstream to downstream of the former dam site. Once the river flow has been located to river-right, the fishway will be removed. Removal of the ladder is expected to take place in relatively dry conditions. A smaller cofferdam or a turbidity curtain enclosure would be used to isolate the downstream extent of the fishway for removal as necessary.

7.4.2 Fish Passage During Sodom Ditch Reconstruction

The Sodom Ditch reconstruction includes rebuilding Sodom Ditch from the Calapooia River-Sodom Ditch bifurcation, downstream through the Sodom Dam site. Downstream fish passage will be maintained during the Sodom Ditch reconstruction bypassing flow through a 24 inch HDPE pipe. Due to the pipe length and velocities, upstream fish passage will not be possible during the 1 month channel reconstruction. Steelhead and Chinook are not expected to be impacted by this schedule as the species are not believed to reside in the project reach during the in-water work period due to high water temperatures.

There is the potential for juvenile Chinook and steelhead as well as other fish species to be affected by project operations. However, fish passage will be maintained during the Sodom Dam removal and Sodom Ditch reconstruction projects. Fish salvage will be completed to remove stranded fish from the project area.

7.4.3 Fish Passage During Shearer Dam Removal

The height of Shearer Dam precludes fish passage over the dam during low to moderate flows. As the river stage increases, the vertical height over the dam diminishes as the downstream stage rises. Due to

the low gradient nature of the Calapooia River, the jump height over the dam is flooded out at less than a bankfull flood event. Like Sodom Dam, Shearer Dam has a substandard fishway (Figure 7-2) on the west side of the dam that is believed to further limit fish passage past the dam site due to periodic debris plugging. The cofferdam constructed upstream of the dam will divert water through the existing fishway. The fishway will be cleaned of debris as necessary during the diversion period. Flows in the Calapooia River through the Shearer Dam site are not expected to exceed 50 cfs during the project period.



Figure 7-2. The Shearer Dam fishway inlet. The fishway is of similar pool-notch construction as the Sodom Dam fishway. Photo courtesy Crispin (2010).

Due to project site access limitations, the bulk bag cofferdam will be built from river-left to river-right. A temporary 36 inch culvert will be placed in the cofferdam immediately upstream of the fishway to provide flow through the cofferdam and into the fishway. This arrangement will permit fish passage through the project site and allow dam deconstruction access from only the river-left side of Shearer Dam. Once the main portion of Shearer Dam is removed, round rock will be added to the former footprint of the dam site. The coarse material will be of similar size range to the small-to-medium cobble that is located downstream of the existing dam (Figure 7-3). These materials are believed to be the remnant fill from the historical timber crib dam that pre-dated the existing concrete dam.



Figure 7-3. Shearer Dam on the Calapooia River under low flow (left) and dry (right) conditions. Coarse bed material located downstream from the dam is believed to be remnant material from the historical timber crib dam that preceded the existing concrete dam. Round rock will be imported to provide near-term streambed stability once the dam is removed. Photos courtesy Crispin (2010).

Once the channel bed material and large wood habitat structures have been installed, the cofferdam will be removed from river-right towards river-left. The river flow will be introduced to the river-right side of the channel. Once the river flow has been located to river-right, the fishway will be removed. Removal of the ladder is expected to take place in relatively dry conditions. A smaller cofferdam or at a turbidity curtain enclosure will be used to isolate the downstream extent of the fishway for removal if necessary.

Fish salvage is expected to be necessary between the bulk bag cofferdam and Shearer Dam and the turbidity curtain and Shearer Dam, and then when the river flow is diverted towards river-right and the fishway is abandoned. The fishway will be electrofished prior to its removal.

After completion of the project, there is an expected long-term benefit for Chinook and steelhead with free passage past the former Sodom Dam and Shearer Dam sites. Sediments stored behind the dams that are washed downstream during or after construction are not expected to create downstream fish passage barriers or habitat impairment.

7.5 Riparian and Wetland Restoration

Riparian habitats near the Sodom Dam and Shearer Dam, in the Sodom Ditch reconstruction reach, material staging areas and equipment storage sites will be directly affected by project activities. Riparian vegetation near the dams will be disturbed by construction equipment and material stockpiles, yet these impacts are expected to be short-term and confined to relatively small areas.

Project site revegetation will be completed at the culmination of the project. Example revegetation tasks include seeding and planting native species in disturbed areas, willow cuttings in vegetated soil lifts, and planting native species in the existing riparian zone to increase native species diversity. Site revegetation is expected to improve future stream shading, streambank stability, and contribution of nutrients to the Calapooia River and Sodom Ditch.

7.6 Summary of Short-term Effects

The following sections review the possible effects the project may have on UWR spring Chinook and UWR fall steelhead. Table 7-2 includes the approximate date, task, and potential effects to Chinook and steelhead.

Table 7-2. Potential effects of the Sodom Dam, Shearer Dam, and channel reconstruction efforts on UWR Chinook and steelhead. Date ranges and tasks are taken from Table 7-1.		
Approximate Date	Task	Potential Effect to Chinook and Steelhead
7/15 to 7/31	Establish access routes, stockpile areas, and staging areas	Clearing of riparian vegetation.
8/1 to 8/12	<p>Sodom Dam removal</p> <ul style="list-style-type: none"> - Construct cofferdam and crossing downstream from bifurcation - Remove fishway weirs - Divert Sodom Ditch flow through fishway - Construct bulk bag cofferdam upstream of Sodom Dam - Remove Sodom Dam to fishway - Relocate flow through river-right - Remove Sodom Dam cofferdam - Remove Sodom Dam fishway 	<p>Turbidity and disturbance setting cofferdam and potential fish salvage to remove fish from dewatered areas downstream from the cofferdam.</p> <p>Temporary disturbance while fishway weirs are removed.</p> <p>Potential minor turbidity may affect juvenile fish.</p> <p>Turbidity and disturbance setting cofferdam and fish salvage between cofferdam and Sodom Dam may affect juvenile fish.</p> <p>Turbidity removing cofferdam may affect juvenile fish.</p> <p>Potential minor turbidity may affect juvenile fish.</p> <p>Turbidity removing cofferdam may affect juvenile fish.</p> <p>Potential minor turbidity may affect juvenile fish.</p>
8/15 to 9/2	<p>Shearer Dam removal and stabilization</p> <ul style="list-style-type: none"> - Construct bulk bag cofferdam, work pad and install temporary culvert - Divert Calapooia River through fishway - Remove Shearer Dam to fishway - Stabilize Calapooia River 	<p>Turbidity and disturbance setting cofferdam and fish salvage between cofferdam and Shearer Dam may affect juvenile fish.</p> <p>No disturbance expected other than project activity.</p> <p>Potential minor turbidity may affect juvenile fish.</p> <p>Potential minor turbidity may affect juvenile fish.</p>

Table 7-2. Potential effects of the Sodom Dam, Shearer Dam, and channel reconstruction efforts on UWR Chinook and steelhead. Date ranges and tasks are taken from Table 7-1.		
Approximate Date	Task	Potential Effect to Chinook and Steelhead
	<ul style="list-style-type: none"> - Remove Shearer Dam cofferdam - Remove Shearer Dam fishway - Complete Shearer Dam site clean-up and revegetation 	<p>Turbidity removing cofferdam may affect juvenile fish.</p> <p>Potential minor turbidity may affect juvenile fish.</p> <p>No expected effects.</p>
9/5 to 10/7	<p>Sodom Ditch Reconstruction</p> <ul style="list-style-type: none"> - Divert Sodom Ditch flow into 24 inch HDPE pipe to bypass project area - Channel reconstruction - Remove bypass pipe and cofferdam downstream from bifurcation 	<p>Turbidity and disturbance setting pipe. Fish salvage from project area.</p> <p>Turbidity will not influence downstream clear water since flow will bypass project reach.</p> <p>Turbidity removing cofferdam may affect juvenile fish.</p>
10/3 to 10/14	<p>Calapooia River at Bifurcation Reconstruction</p> <ul style="list-style-type: none"> - Install work area isolation turbidity curtains in bifurcation area - Stabilize Calapooia River in bifurcation area 	<p>Turbidity and disturbance setting turbidity curtains may affect juvenile fish.</p> <p>Turbidity and disturbance building engineered log jams and grade control may affect juvenile fish.</p>
10/17 to 10/31	<p>Project Areas Clean-up</p> <ul style="list-style-type: none"> - Out-haul construction debris to appropriate disposal area - Re-grade disturbed areas to pre-project or historical topography - Site revegetation 	<p>No effects expected as work to be completed above ordinary high water elevation</p> <p>No effects expected as work to be completed above ordinary high water elevation</p> <p>No effects expected as work to be completed above ordinary high water elevation</p>

7.7 Long-term Effects

This project would remove the last mainstem dams on the Calapooia River and Sodom Ditch, providing unimpeded upstream and downstream movement for anadromous fish. The project is expected to improve the potential recovery of UWR spring Chinook and fall steelhead populations in the Calapooia River. Removal of the two dams will restore the river to a more natural system capable of creating and

maintaining habitats and passage for the target species. Given the low numbers of Chinook and steelhead in the Calapooia River, any improvements to habitat and passage should result in greater population recovery potential.

7.8 Impact Avoidance and Minimization Measures

As discussed above, the proposed actions will cause short-term impacts that may adversely affect UWR spring Chinook and UWR winter steelhead or their habitat. To limit these impacts, the contractor will implement the following avoidance and minimization measures.

7.8.1 Construction Schedule

The in-water work for the dam removal is scheduled to occur within ODFW's recommended in-water work window (June 1 through October 15) when there are fewer fish likely to be within the river system. Construction is planned to begin July 15, 2011. By deploying two work crews, project construction is expected to be completed during the in-water work window.

7.8.2 Construction Work Areas

Staging areas, temporary access roads, and stockpile areas will be confined to the minimum area necessary to complete the project. Prior to equipment mobilization, the work area boundaries will be clearly marked to prevent disturbances of sensitive areas.

7.8.3 Vegetation Removal

All areas disturbed during construction will be revegetated immediately following construction. Planting will consist of native perennials and grasses suitable for the work areas.

7.8.4 Isolation of In-Water Work Area

In-water work areas will be isolated from the river flow to avoid juvenile Chinook and steelhead that may be present near the project sites. No pile driving or sheet piles will be used in cofferdam construction in favor of bulk bags. Dam deconstruction and river reconstruction activities will take place in isolation from active flow. Following the dam removals and the Sodom Ditch reconstruction, specific cofferdams will be removed incrementally as not to cause fish stranding upstream of the respective cofferdam. An ODFW biologist will be present during this process to monitor for fish stranding. The design of the cofferdam allows for reversing the river rewatering process should unforeseen fish stranding occur. The construction of a temporary cofferdam to provide an in-river work platform for removal of the dams will minimize disturbance to riparian areas and minimize bank erosion and potential turbidity associated with construction activities. Additionally, the cofferdams will be composed primarily of native material harvested elsewhere in the Calapooia River watershed.

7.8.5 Fish Capture and Release

Under guidance of an ODFW biologist, efforts will be taken to capture and release fish detained in isolated work areas. Fish salvage will be the most effective means for the varying site conditions, including trapping, seining, or backpack electrofishing. Records of captured fish will be submitted to NMFS following the project. More information about the fish salvage plan is present in Appendix B.

7.8.6 Fish Passage

Adult and juvenile fish passage will be maintained during the removal of Sodom Dam and Shearer Dam. Downstream fish passage will be maintained during Sodom Ditch reconstruction. Upstream fish passage will not be maintained during the Sodom Ditch reconstruction in order to provide efficient channel dewatering and construction conditions.

7.8.7 Heavy Equipment

The use of heavy equipment will be used under the following restrictions to minimize the likelihood of spills of fuel or other hazardous materials:

- Staging, cleaning, maintenance, refueling, and fuel storage will take place in a vehicle staging area placed 150 feet or more from any stream, waterbody, or wetland.
- All heavy equipment operation within 150 feet of any stream, waterbody, or wetland will be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected will be repaired in the vehicle staging area before the vehicle resumes operation. Inspections will be documented in a record that is available for review on request by the Corps or NMFS.
- All equipment operated in-stream will be cleaned before beginning operations below the bankfull elevation to remove all external oil, grease, dirt and mud.

7.8.8 Erosion Control

The contractor will submit an Erosion and Sedimentation Control Plan (ESCP) in accordance with guidance from NMFS. This contractor-prepared plan will be specific to the construction techniques to be employed and will include the following:

- Erosion control measures will be in place at all times during construction. Construction within the 25-year floodplain will not begin until all temporary erosion controls are in place. Erosion control structures will be maintained throughout the construction work period.
- All erosion control structures will be inspected daily during construction to ensure they are working adequately. Work crews will be mobilized to make immediate repairs to the erosion controls, or to install erosion controls during working and off-hours. Should a control measure not function effectively, the control measure will be repaired or replaced immediately. Additional controls will be installed as necessary, with the goal of minimizing turbidity and sedimentation.
- Other erosion control measures may be required depending on changes in anticipated streamflow conditions or failure of proposed measures.
- A pollution control plan (PCP) will be developed to prevent point-source pollution related to contractor operations. This plan will satisfy all pertinent requirements of federal, state, and local laws and regulations, and the requirements of this project. All efforts will be made to establish erosion control measures sufficient to prevent the discharge of significant amounts of sediment to surface waters and ensure that turbidity does not exceed 10% above background conditions.

8 CRITICAL HABITAT

NMFS designated critical habitat for UWR spring Chinook and UWR fall steelhead in 2005 and includes the Calapooia River and Sodom Ditch within the action area. “Critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line (33 CFR 319.11). In areas where ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge which generally has a recurrence interval of 1 to 2 years on the annual flood series.” (50 CFR 226.212). NMFS believes that preservation and enhancement of this habitat is essential for the recovery of UWR Chinook and steelhead. The Calapooia River HUC 1709000303) provides 1) space for individual and population growth, and for normal behavior; 2) food, water, air, light, minerals, or other nutritional or physiological requirements; 3) cover or shelter; 4) sites for breeding, reproduction, or rearing offspring; and, 5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of this species (see, 50 CFR 424.12(b)).

This project would improve the long-term aspects of the UWR Chinook and steelhead critical habitat by removing longtime barriers to fish passage and restoring natural hydrology and sediment transport. Yet, there will be short-term effects to critical habitat during construction. When considering these effects, NMFS reviews the project’s influence on known physical and biological features, known as primary constituent element (PCEs), which are believed to be essential for the conservation of the species, including, but not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation.

Table 8-1. The potential effects of the proposed action on primary constituent elements for UWR Chinook and steelhead.	
Primary Constituent Element	Potential Effect From the Proposed Action
Substrate	Sediment stored upstream of Sodom Dam will be modified during the Sodom Ditch reconstruction. Sediment stored upstream of Sodom Dam and Shearer Dam are derived from materials in the watershed and are not expected to negatively impact downstream habitat conditions.
Water quality	Suspended sediments will be increased as native material is transported from the reconstructed Sodom Ditch reach. Fine sediment stored upstream of Shearer Dam will erode and be transported downstream. The fine sediment will largely be mobilized in suspension and are expected to deposit over a long distance of the Calapooia River. Removal of both dams will result in the replacement of low velocity reservoir habitat with higher velocity riverine habitat.
Water quantity	Water quantity in the project reach will not change as the existing dams are flow-through structures.
Water temperature	Water temperatures may change slightly with the conversion of the reservoir environments to riverine environments. Water temperature changes would likely be small enough to be within the temperature range of the existing condition.
Water velocity	Restoration of natural hydrology. No water velocity barriers are expected during project construction due to the low gradient nature of the Calapooia River and low flows on both the Calapooia River and Sodom Ditch.

Table 8-1. The potential effects of the proposed action on primary constituent elements for UWR Chinook and steelhead.	
Primary Constituent Element	Potential Effect From the Proposed Action
Cover/shelter	Possible loss of some overhead vegetation is likely with the Sodom Ditch reconstruction. Loss of canopy trees and shrubs will be minimized.
Food	No adverse effect on primary productivity. Minor temporary impacts to macroinvertebrates in the immediate vicinity of the project.
Riparian vegetation	Some riparian function will be temporarily disrupted adjacent to the dams and in the Sodom Ditch reconstruction reach. The revegetation plan will re-establish native plant species in the project areas,
Space	No change from current condition.
Safe passage conditions	Long-term benefit with the removal of fish passage barriers and displacement of habitat types preferred by introduced predatory fish species (e.g. large mouth bass).

In conclusion, there would be no long-term adverse effects to UWR Chinook and steelhead critical habitat. Safe passage conditions in the Calapooia River are currently limited with the presence of Sodom Dam and Shearer Dam and the proposed action will restore this important critical habitat element.

9 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. Other than the continuation of existing land uses in the watershed including timber harvest in the headwaters and predominantly grass seed farming and other agriculture in the middle and lower watershed, we are not aware of any specific future nonfederal activities within the action area that would adversely affect UWR Chinook or steelhead, or the declared critical habitat.

10 FINDING OF EFFECT

The following determination of effect for UWR Chinook and steelhead and their critical habitat is contingent of implementation of the previously identified impact minimization measures (section 7.8).

10.1 Upper Willamette River Chinook

The project **may affect**, but is **not likely to adversely affect** the UWR Chinook ESU. A *may affect* determination is warranted because:

- The project is located in an area that supports UWR Chinook, and suitable habitats are present within the action area.
- Removal of Sodom Dam and Shearer Dam would involve in-water work when fish are present.
- Water quality will be temporarily degraded as a result of the in-water work due to periodic short-term turbidity releases.

A *not likely to adversely affect* determination is warranted because:

- The population of Chinook salmon that uses the Calapooia River is small and no Chinook redds have been identified by ODFW in the upper mainstem spawning reach in the last three years.
- Habitat conditions in the project reach during the in-stream work window are characterized by low flows and elevated water temperatures. Conditions are not conducive to juvenile Chinook salmon rearing.
- Juvenile and adult Chinook salmon are not expected to be in the project reach during the in-stream work window. Juvenile Chinook outmigrate in the fall and spring and adults migrate from mid-April through July with most of the migration taking place in May and June.

The extent of take of UWR Chinook would be minimized because:

- Project actions will take place within ODFW's recommended in-water work period when Chinook are less likely to be present in the action area.
- In-water work areas would be isolated from river flows to minimize effects from turbidity and sedimentation.
- Areas disturbed during the dam removals would be restored and planted with native vegetation.
- Fish salvage efforts would comply with NMFS recommendations (NMFS, 2000) and be supervised by an ODFW biologist.

10.2 Upper Willamette River Steelhead

The project **may affect**, but is **not likely to adversely affect** the UWR steelhead distinct population segment (DPS). A *may affect* determination is warranted because:

- The project is located in an area that supports UWR steelhead, and suitable habitats are present within the action area.
- Removal of Sodom Dam and Shearer Dam would involve in-water work when fish are present.
- Water quality will be temporarily degraded as a result of the in-water work due to periodic short-term turbidity releases.

A *not likely to adversely affect* determination is warranted because:

- The population of steelhead that uses the Calapooia River is small and steelhead primarily use the headwater portions of the watershed.
- Habitat conditions in the project reach during the in-stream work window are characterized by low flows and elevated water temperatures. Conditions are not conducive to juvenile steelhead rearing.
- Juvenile and adult steelhead are not expected to be in the project reach during the in-stream work window. Juvenile steelhead outmigrate in the spring and adults migrate from December through April with most of the migration taking place in February and March. Juvenile steelhead rear in the Calapooia River year-round though rearing is likely limited to upstream reaches characterized by cooler summer water temperatures.

The extent of take of UWR steelhead would be minimized because:

- Project actions will take place within ODFW's recommended in-water work period when steelhead are less likely to be present in the action area.

- In-water work areas would be isolated from river flows to minimize effects from turbidity and sedimentation.
- Areas disturbed during the dam removals would be restored and planted with native vegetation.
- Fish salvage efforts would comply with NMFS recommendations (NMFS, 2000) and be supervised by an ODFW biologist.

10.3 Critical Habitat

The project **may affect** but **is not likely to adversely modify** the designated critical habitat of UWR Chinook salmon and steelhead. A *may affect* determination is warranted because:

- The Calapooia River is designated critical habitat of UWR Chinook salmon and steelhead, and PCEs associated with migration and rearing are present in the action area. However, water quality during the in-stream work window in the action area is likely inhospitable for juvenile rearing.
- The project includes removal of riparian vegetation and disturbance of streambed within designated critical habitat.

A *not likely to adversely modify* determination is warranted because:

- The effects of dam removal activities on streambed substrates, riparian vegetation, and water quality will be temporary and minimized by incorporating native materials in cofferdam design, replanting disturbed areas, and implementing erosion control measures.
- The dam removals will restore the Calapooia River and Sodom Ditch to natural conditions, providing a long-term benefit to critical habitat despite short-term construction-related impacts.

10.4 Request for Consultation

Based on this finding of effect on a protected fish species, NMFS is requesting initiation of formal consultation in accordance with Section 7 of the ESA and implementing the regulation found in 50 CFR 402.14.

11 ESSENTIAL FISH HABITAT

Public Law 104-267, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act [MSA]) to establish requirements for federal agencies to consult with NMFS on activities that may adversely affect essential fish habitat (EFH). EFH is defined as the waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity to ensure the production needed to support a long-term sustainable fishery (i.e., properly functioning habitat conditions necessary for the long-term survival of the species through the full range of environmental variation). The consultation requirements of section 305(b) of the Magnuson-Stevens Act (16 U.S.C. 1855(b)) provide that:

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

For this project, NMFS is the federal agency responsible for the action that may impact EFH. Therefore, conservation recommendations in this EFH assessment represent the measures that NMFS believes to best conserve EFH during the proposed action.

11.1 Identification of EFH

Under the MSA, the Pacific Fisheries Management Council designated EFH for three species of federally-managed Pacific salmon: Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kitsuch*), and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other waterbodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable artificial barriers (PFMC 1999), and longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). In this case, EFH includes the Calapooia River both above and below the project area. Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 of the Pacific Coast Salmon Plan (PFMC 1999).

11.2 Proposed Action

The proposed action is detailed in Section 2 of this BA.

11.3 Effects of Proposed Action on EFH

As described in detail in Section 5 of this BA, the proposed action may result in short- term adverse effects to a variety of habitat parameters important to Chinook salmon and steelhead.

Table 11-1. The potential effects of the removal of Sodom and Shear dams on EFH habitat features.

Habitat Features	Effects of Proposed Action
Substrate composition	Removal of the dams will restore natural sediment transport processes. Sediment stored behind the dams is composed of native materials similar to substrate compositions found downstream; therefore, redistribution of stored sediment will not significantly alter the existing substrate composition. Cofferdam installation and dam removal activities may temporarily increase suspended sediment in the action area. Suspended sediment has the potential to settle out on top of existing substrate further downstream, possibly affecting the quality of spawning and rearing habitat, although most spawning and rearing habitat is located in the upper watershed upstream of the action area. High winter flows will likely disperse fine sediments that settle out during summer low-flow periods. Chinook salmon and steelhead generally do not spawn in or downstream of the action area and therefore these lifestages are not expected to be affected by temporary changes in substrate composition.
Water quality	Increases in suspended sediment will occur periodically for during project construction and for a short time during runoff on Sodom Ditch. Suspended sediments will likely be mobilized for a longer period of time on the Calapooia River due to the more extensive sediment deposition related to Shearer Dam. The rate at which fine sediment deposited upstream of Shearer Dam is eroded and mobilized downstream will depend on the frequency of flood events and the volume of stored material. Dissolved oxygen and water temperature are not expected to be adversely affected by the project.

Table 11-1. The potential effects of the removal of Sodom and Shear dams on EFH habitat features.	
Habitat Features	Effects of Proposed Action
Water quantity	No change from current condition. Sodom Dam and Shearer Dam do not currently regulate river flow. The distribution of flow between Sodom Ditch and the Calapooia River are expected to remain similar following the project. Any changes that do occur will be spatially limited as the Calapooia River and Sodom Ditch rejoin downstream of the action area.
Channel gradient and stability	Changes to channel gradient and form will occur following the dam removals. The Calapooia River through the Shearer Dam site will be stabilized with coarse bed material. This action is warranted to control channel the rate of channel bed degradation upstream of the former Shearer Dam site. The Calapooia River upstream of the former Shearer Dam site is expected to degrade over time, steepening the channel slope. Sodom Ditch upstream and through the former Sodom Dam site will be reconstructed to maintain channel stability following dam removal. Impacts downstream of the dam sites are not expected other than fine sediment deposition.
Food	Short term increases in turbidity will occur around the immediate vicinity of the cofferdams during installation and removal. Temporary increases in turbidity and suspended sediment will occur when the dams are removed and sediments stored behind the dams are eroded during peak flood flows. Movement of sediments will not result in chronic elevation of turbidity levels over large areas of the river. No long-term effects are expected to occur to primary productivity or to other food sources such as macroinvertebrates.
Cover and habitat complexity (large woody debris, pools, channel complexity, aquatic vegetation)	Construction activities include removing Sodom Dam and Shearer Dam, reconstructing Sodom Ditch and stabilizing the Calapooia River channel. Processes that generate large woody debris will not be affected. Installation of engineered log jams, engineered riffles, vegetated soil lifts and completion of a revegetation plan will increase channel complexity on the Sodom Ditch. Channel complexity will be increased slightly on the Calapooia River with the installation of engineered log jams and completion of a revegetation plan.
Space	No changes from current condition.
Access and passage	Removal of the dams will restore unimpeded access to upstream habitat. Mortalities and delayed migration associated with Sodom Dam and Shearer Dam will be eliminated.
Floodplain and habitat connectivity	No floodplain connectivity changes from current condition. Longitudinal river habitats will be better connected with the dam removals.

12 REFERENCES

- Ainslie, B. J., J. R. Post, A. J. Paul. 1998. Effects of Pulsed and Continuous DC Electrofishing on Juvenile Rainbow Trout. *North American Journal of Fisheries Management*: Vol. 18, No. 4, pp. 905–918.
- Berg, L., and T. G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. *Canadian Journal of Fisheries and Aquatic Science* 42: 1410-1417.
- Bell, E. S. Kramer, D. Zajanc, and J. Aspittle. 2008. Salmonid Fry Stranding Mortality Associated with Daily Water Level Fluctuations in Trail Bridge Reservoir, Oregon. *North American Journal of Fisheries Management*: Vol. 28, No. 5, pp. 1515-1528.
- Bisson, P. A., and R. E. Bilby. 1982. Avoidance of suspended sediment by juvenile coho salmon. *North American Journal Fisheries Management* 4: 371-374.
- Busby P. J., T.C. Wainwright, G. J. Bryant, L. Leirheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon and California. U.S. Dept. Commerce, National Oceanic and Atmospheric Administration Tech. Memo. NMFS-NWFSC-27.
- Calapooia Watershed Council. 2004. Calapooia River Watershed Assessment. Prepared by Biosystems, Water Work Consulting, and Alsea Geospatial for the Calapooia Watershed Council. Brownsville Oregon.
- Chilcote, M. W. 1998. Conservation Status of Steelhead in Oregon. Oregon Department of Fish and Wildlife, Information Reports Number 98-3, Portland.
- Crispin, D. 2010. Thompson's Mills State Heritage Park Operations Manual. 579 p.
- Dalbey, S. R., T. E. McMahon, and W. Fredenberg. 1996. Effect of electrofishing pulse shape and electrofishing-induced spinal injury to long-term growth and survival of wild rainbow trout. *North American Journal of Fisheries Management* 16:560-569.
- Federal Highway Administration. 2008. Effective Noise Control During Nighttime Construction – FHWA Work Zone – Mozill. December 22, 2008. http://ops.fhwa.dot.gov/wz/workshops/accessible/Schexnayder_paper.htm
- Gregory, R. S., and T. S. Northcote. 1993. Surface, planktonic, and benthic foraging by juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in turbid laboratory conditions. *Canadian Journal of Fisheries and Aquatic Sciences* 50: 223-240.
- Hastings, M. C. 2002. Clarification of the meaning of sound pressures levels and the known effects of sound on fish. White paper. August 2002.
- Howell, P., K. Jones, D. Scarnecchia, and L. LaVoy. 1985. Stock assessment of Columbia River anadromous salmonids, Volume I: Chinook, coho, chum, and sockeye salmon summaries. Final report. Bonneville Power Administration, Portland, Oregon.
- Lloyd, D. S. 1987. Turbidity as a Water Quality Standard for Salmonid Habitats in Alaska. *North American Journal. Fish. Mgmt.* 7:34-45.
- Mattson, C. R. 1948. Spawning ground studies of Willamette River spring Chinook salmon. *Research Briefs of the Oregon Fish Commission* 1(2):21-32.

- Mattson, C. R. 1963. An investigation of adult spring Chinook salmon for the Willamette River system, 1946-51. Oregon Fish Commission, Portland.
- McElhany, P., T. Backman, C. Busack, S. Heppell, S. Kolmes, A. Maule, J. Myers, D. Rawding, D. Shively, A. Steel, C. Steward, and T. Whitesel. 2003. Interim Report on Viability Criteria for Willamette and Lower Columbia Basin Pacific Salmonids. Willamette/Lower Columbia Technical Recovery Team. Northwest Fisheries Science Center, Seattle WA.
- McElhany, P., T. Backman, C. Busack, S. Kolmes, J. Myers, D. Rawding, A. Steel, C. Steward, T. Whitesel, and C. Willis. 2004. Status Evaluation of Salmon and Steelhead Populations in the Willamette and Lower Columbia Basins. Willamette/Lower Columbia Technical Recovery Team, Northwest Fisheries Science Center, Seattle WA.
- McElhany, P., M. Chilcote, J. Myers, and R. Beamesderfer. 2007. Viability status of Oregon salmon and steelhead populations in the Willamette and Lower Columbia Basins. Prepared for Oregon Department of Fish and Wildlife and National Marine Fisheries Service. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington.
- McMichael, G., A. L. Fritts, and T. N. Pearsons. 1998. Electrofishing Injury to Stream Salmonids; Injury Assessment at the Sample, Reach, and Stream Scales. North American Journal of Fisheries Management 18:894-904.
- Myers, J., C. Busack, D. Rawding, A. Marshall, D. Teel, D.M. Van Doornik, and M.T. Maher. 2006. Historical population structure of Pacific salmonids in the Willamette River and lower Columbia River basins. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-73, 311 p.
- NMFS (National Marine Fisheries Service). 1997. Endangered and threatened species; listing of several Evolutionarily Significant Units (ESUs) of West Coast steelhead. Final rule. Federal Register 62 (18 August):43937-43954.
- NMFS (National Marine Fisheries Service). 2000. National Marine Fisheries Service Backpack Electrofishing Guidelines. NMFS, Portland, OR. 5 pgs.
- NMFS (National Marine Fisheries Service). 2004. Programmatic Biological and Conference Opinion and Magnusson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Revised Standard Local Operating Procedures for Endangered Species to Administer Certain Activities Authorized or Carried Out by the Department of the Army in the State of Oregon and on the North Shore of the Columbia River. November 30, 2004. NOAA Fisheries No. 2004/01043, Northwest Region, Seattle, WA.
- NMFS (National Marine Fisheries Service). 2005a. Policy on the consideration of hatchery-origin fish in Endangered Species Act listing determinations for Pacific salmon and steelhead. Federal Register 70:123(28 June 2005):37204-37216.
- NMFS (National Marine Fisheries Service). 2005c. Endangered and threatened species; final listing determinations for 16 evolutionarily significant units of West Coast salmon, and final 4(d) protective regulations for threatened salmonid ESUs. Final rule. Federal Register 70:123(28 June 2005):37160-37204.
- NMFS (National Marine Fisheries Service). 2006b. Endangered and threatened species: final listing determinations for 10 distinct population segments of West Coast Steelhead. Final rule. Federal Register 71:3(5 January 2006):834-862.

- Newcombe, C. P., and J. O. Jensen. 1996. Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact. *North American Journal of Fisheries Management* 16, No. 4.
- Nehlsen, W., J. E. Williams, and J. A. Lichatowich. 1991. Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington. *Fisheries*, Vol. 16, No. 2. Bethesda, MD.
- Nicholas, J. 1995. Status of Willamette spring-run Chinook salmon relative to Federal Endangered Species Act. Report to the National Marine Fisheries Service by the Oregon Department of Fish and Wildlife, Salem.
- Oregon Department of Environmental Quality. 2010. TMDL Program – The Willamette Basin. <http://www.deq.state.or.us/wq/tmdls/willamette.htm>.
- ODFW (Oregon Department of Fish and Wildlife). 2008c. Fisheries management and evaluation for 2007 Willamette River spring Chinook. ODFW, Ocean Salmon and Columbia River Program, Clackamas.
- Oregon Natural Heritage Information Center (ORNHC). 2010. Action Area Threatened and Endangered Species Request.
- Pacific Fishery Management Council (PFMC). 1999. Appendix A – Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon, Amendment 14 to the Pacific Coast Salmon Plan. Portland, Oregon.
- Parkhurst, Z. E., F. C. Bryant, and R. S. Nielson. 1950. Survey of the Columbia River and its tributaries. Part 3 (Area 2). U.S. Fish and Wildlife Service Special Scientific Report - Fisheries No. 36.
- Popper, A. N., J. Fewtrell, M. E. Smith, R. D. McCauley. 2003. Anthropogenic Sound: Effects on the Behavior and Physiology of Fishes. *Marine Technology Society Journal* Vol. 37, no. 4, pp. 35-40. 2003-2004.
- Reeves, G. H., F. H. Everest, and T.E. Nickelson. 1989. Identification of physical habitats limiting the production of coho salmon in western Oregon and Washington. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.
- River Design Group, Inc. 2009a. Sodom Dam Fish Passage and Dam Removal Preliminary Alternatives. 7 pp.
- River Design Group, Inc. 2009b. Calapooia River – Sodom Dam Project Alternatives and Hydraulic Modeling Scenarios. 19 pp.
- River Design Group, Inc. 2009c. Calapooia River Geomorphic Assessment Sodom Dam Bifurcation to Butte Creek Confluence. 80 pp.
- River Design Group, Inc. 2009d. Hydraulic modeling summary for Sodom Dam Alternatives Feasibility Study. Technical Memorandum. 12 pp.
- Schroeder, R. K., and K. R. Kenaston. 2004. Fish Research Project Oregon: spring Chinook salmon in the Willamette and Sandy Rivers. Annual progress report October 2003 through September 2004. Oregon Department of Fish and Wildlife, Salem.
- Servizi, J.A. and D.W. Martens. 1992. Sublethal responses of coho salmon (*Oncorhynchus kisutch*) to suspended sediments. *Can. J. Fish. Aquat. Sci.*, 49: 1389-1395.

- Sharber, N. G. and S. W. Carothers. 1988. Influence of electrofishing pulse shape on spinal injuries in adult rainbow trout. *North American Journal of Fisheries Management* 8:117-122.
- Sigler, J., T. C. Bjornn, and F. H. Everest. 1984. Effects of chronic turbidity on density and growth of steelhead and coho salmon. *Transactions of the American Fisheries Society* 113:142-150.
- Tetra Tech. 2008. Sodom Ditch Dam Conversion Project Hydraulic Analysis and Modeling Task Summary. 18 pp.
- USACE (U.S. Army Corps of Engineers). 2004. Biological Assessment – Columbia River Channel Operations and Maintenance – Mouth of the Columbia River to Bonneville Dam.
- USACE (U.S. Army Corps of Engineers). 2006. Green Peter and Foster Dams and Reservoirs. USACE, Portland District, Portland, Oregon.
- USACE (U.S. Army Corps of Engineers), Bonneville Power Administration (BPA), and Reclamation (U.S. Bureau of Reclamation). 2007. Supplemental biological assessment of the effects of the Willamette River Basin Flood Control Project on species listed under the Endangered Species Act. USACE, Portland, Oregon.
- U.S. Interagency Advisory Committee on Water Data. 1982. Guidelines for determining flood flow frequency, Bulletin 17-B of the Hydrology Subcommittee: Reston, Virginia, U.S. Geological Survey, Office of Water Data Coordination. 183 p.
- Willis, R.A., M.D. Collins, and R.E. Sams. 1960. Environmental survey report pertaining to salmon and steelhead in certain rivers of Eastern Oregon and the Willamette River and its tributaries. Part II: survey reports of the Willamette River and its tributaries.

**APPENDIX A
RESOURCE MAPS**
