United States Department of the Interior

FISH AND WILDLIFE SERVICE

Western Washington Fish and Wildlife Office
510 Desmond Drive SE, Suite 102
Lacey, Washington 98503

APR 1 5 2004

Memorandum

To: Deputy Regional Director, Pacific Region
Portland, Oregon

From: Manager, Western Washington Fish and Wildlife Office
Lacey, Washington

Subject: Biological Opinion for the Proposed Issuance of a Section 10(a)(1)(B) Incidental Take Permit (PRT-TE064055-0) to J.L. Storedahl and Sons, Inc., for the Daybreak Mine Expansion and Habitat Enhancement Project, Habitat Conservation Plan (USFWS Log# 1-3-04-FWF-0726)

This document transmits the Service's biological opinion regarding the issuance of an incidental take permit (ITP) (PRT-TE064055-0) to J.L. Storedahl and Sons, Inc. (Storedahl) for the implementation of the Daybreak Mine Expansion and Habitat Enhancement Project, Habitat Conservation Plan. Issuance of an ITP is pursuant to Section 10(a)(1)(B) and Section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The Service proposes to issue the ITP to Storedahl for a period of 25 years.

Storedahl is requesting coverage of incidental take for the federally threatened bull trout, (*Salvelinus confluentus*). Four other unlisted species will also be included in the ITP: coastal cutthroat trout (*Oncorhynchus clarki clarki*), Pacific lamprey (*Lampetra tridentata*), river lamprey (*Lampetra ayresi*), and Oregon spotted frog (*Rana prestiosa*).

Attachments

U.S. FISH and WILDLIFE SERVICE'S BIOLOGICAL and CONFERENCE OPINION for the PROPOSED ISSUANCE of a SECTION 10(a)(1)(B) INCIDENTAL TAKE PERMIT (PRT-TE-064055-0) to the J.L. STOREDAHL and SONS, INC. for the DAYBREAK MINE EXPANSION and HABITAT ENHANCEMENT PROJECT, HABITAT CONSERVATION PLAN

April 2004

TABLE OF CONTENTS

INTRODUCTION

This document constitutes the U.S. Fish and Wildlife Service's (FWS) Biological and Conference Opinions (Opinion) prepared pursuant to section 7 of the Endangered Species Act of 1973, as amended (Act), on the effects of issuing an incidental take permit (ITP) to J.L. Storedahl and Sons, Inc. (Storedahl) for five species, pursuant to section 10(a)(1)(B) of the Act. These Opinions are based on the FWS's review of the Daybreak Mine and Habitat Enhancement Project, Habitat Conservation Plan (HCP) for a 300-acre parcel of land located in Clark County, Washington, and it's effects on bull trout in accordance with the Act (16 U.S.C. 1531 et seq.). The FWS has also prepared conference opinions for the other 4 covered species under our purview (one candidate and three unlisted species) addressed by this HCP. Note that the National Oceanic and Atmospheric Administration (NOAA Fisheries) is preparing a companion Biological Opinion/Conference Opinion on anadromous salmonids for their issuance of an ITP to Storedahl for the four species under their purview. The proposed incidental take of up to nine listed and unlisted species could occur as the result of on-going gravel processing, gravel mine expansion, and mine reclamation activities consistent with the HCP and Implementation Agreement (IA). The nine species that Storedahl is seeking incidental take coverage for include steelhead (*Oncorhynchus mykiss*), Chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), chum salmon (*O. keta*), bull trout (*Salvelinus confluentus*), coastal cutthroat trout (*O. clarki clarki*), Pacific lamprey (*Lampetra tridentata*), river lamprey (*Lampetra ayresi*), and Oregon spotted frog (*Rana prestiosa*).

CONSULTATION HISTORY

From 1997 to 2003 the FWS and NOAA Fisheries (collectively, the Services) provided technical and policy assistance to Storedahl in development of the HCP. During the development of the HCP, preliminary drafts were distributed for comments. The September 1999 draft of the HCP was distributed to several state agencies and several local interested parties for comment. Comments from these groups were incorporated into subsequent drafts of the HCP. The May 2001 draft of the HCP was provided to the Washington Department of Fish and Wildlife (WDFW) for another review under a cooperative agreement between the Western Washington Fish and Wildlife Office (WWFWO) and WDFW. Comments from this review were incorporated into the final draft of the HCP.

The Services also worked with Storedahl to develop an IA and Environmental Impact Statement (EIS) to accompany the HCP. Storedahl submitted a formal application for an ITP in November 2002, and on November 22, 2002 the Services initiated a 60-day public comment period under the National Environmental Policy Act of 1969, as amended (NEPA) (63 FR 68469). The public comment was extended an additional 30-days ending February 21, 2003.

The Services and Storedahl prepared a Final NEPA EIS, Response to Comments, and a Final HCP with Technical Appendices. These documents were made available to the public on November 28, 2003, for a 30-day public review period. This public review period was extended an additional 30-days and ended January 28, 2004.

This Opinion is based on the October 2003 final HCP, IA, November 2003 Final EIS including the Response to Public Comments, and several years of discussions and negotiations with Storedahl and his consultants. A complete administrative record of this HCP is on file in the FWS's WWFWO in Lacey, Washington.

Initiation of consultation was considered to have begun on October 15, 2002, upon receipt by the WWFWO of Portland Regional Office's intra-Service section 7 evaluation form, where-in the Regional Office requested the WWFWO initiate formal consultation on the HCP.

BIOLOGICAL AND CONFERENCE OPINIONS

DESCRIPTION OF THE PROPOSED ACTION

Storedahl has prepared a multi-species HCP and applied for a section 10(a)(1)(B) ITP to comply with the Act and to address the effects associated with the proposed gravel mine expansion, gravel processing, and site reclamation activities in the HCP. An existing on-site plant, until recently, processed gravel aggregate mined from off-site locations. The expanded mining plan will continue to use the existing plant for processing, stockpiling, and distributing aggregate that will be mined from both on- and off-site locations. The expected life of the on-site mining activities is 10 to 15 years, depending on market conditions and other factors.

The East Fork Lewis River originates in the foothills of the western Cascade Mountains, draining an area of 212 square miles. The river flows westward for 43 miles, joining the Lewis River approximately 3 miles upstream of the Columbia River just north of the Ridgefield National Wildlife Refuge. The Columbia River flows an additional 87 miles before emptying into the Pacific Ocean. The lower 5.9 miles of the East Fork Lewis River is tidally influenced (Hutton 1995), but this influence can extend as far up the East Fork as River Mile 7.3 (RM) when flooding coincides with a high tide (FEMA 1991). The Daybreak Mine site is located in a flat alluvial valley at RM 8.0 on the north side of the East Fork Lewis River (see HCP Figure 1-1). The East Fork Lewis River's gradient abruptly decreases in the vicinity of the Daybreak Mine site to less than one percent, resulting in the deposition of coarse sediment transported by the river from upstream areas. This deposition has over time resulted in an area rich in gravel resources. Other than agricultural activities, which cleared, filled, and graded the natural surface features of the site, prior excavations and active gravel processing facilities comprise the major existing structural features at the Daybreak Mine site.

Previous mining of the Daybreak Mine site resulted in the formation of five unnamed ponds (see HCP Figure 1-2) (approximately 64 acres) that are in various stages of reclamation or that have performed important functions for the processing of imported raw materials during past operations. The gravel-processing area (approximately 23 acres) is where material imported from off-site locations was processed and stockpiled. Gravel is still occasionally stockpiled at the site. The processing area includes the Storedahl Pit Road, storage areas for excavation equipment, aggregate processing equipment, processed sand and gravel, fuel storage tanks, parking areas, temporary haul roads, and an office, scales, and maintenance shop.

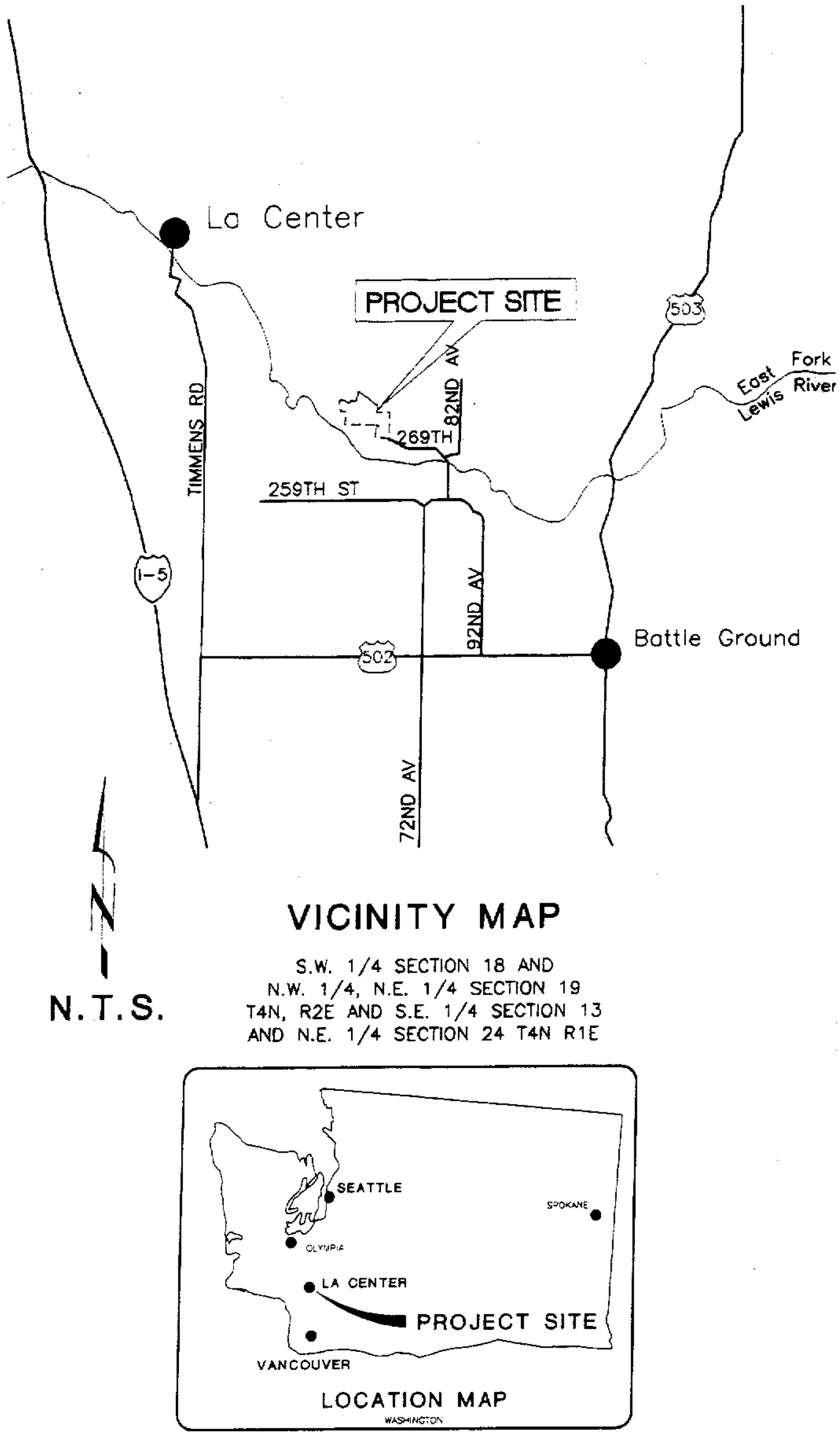


Figure 1-1. Project Location Map

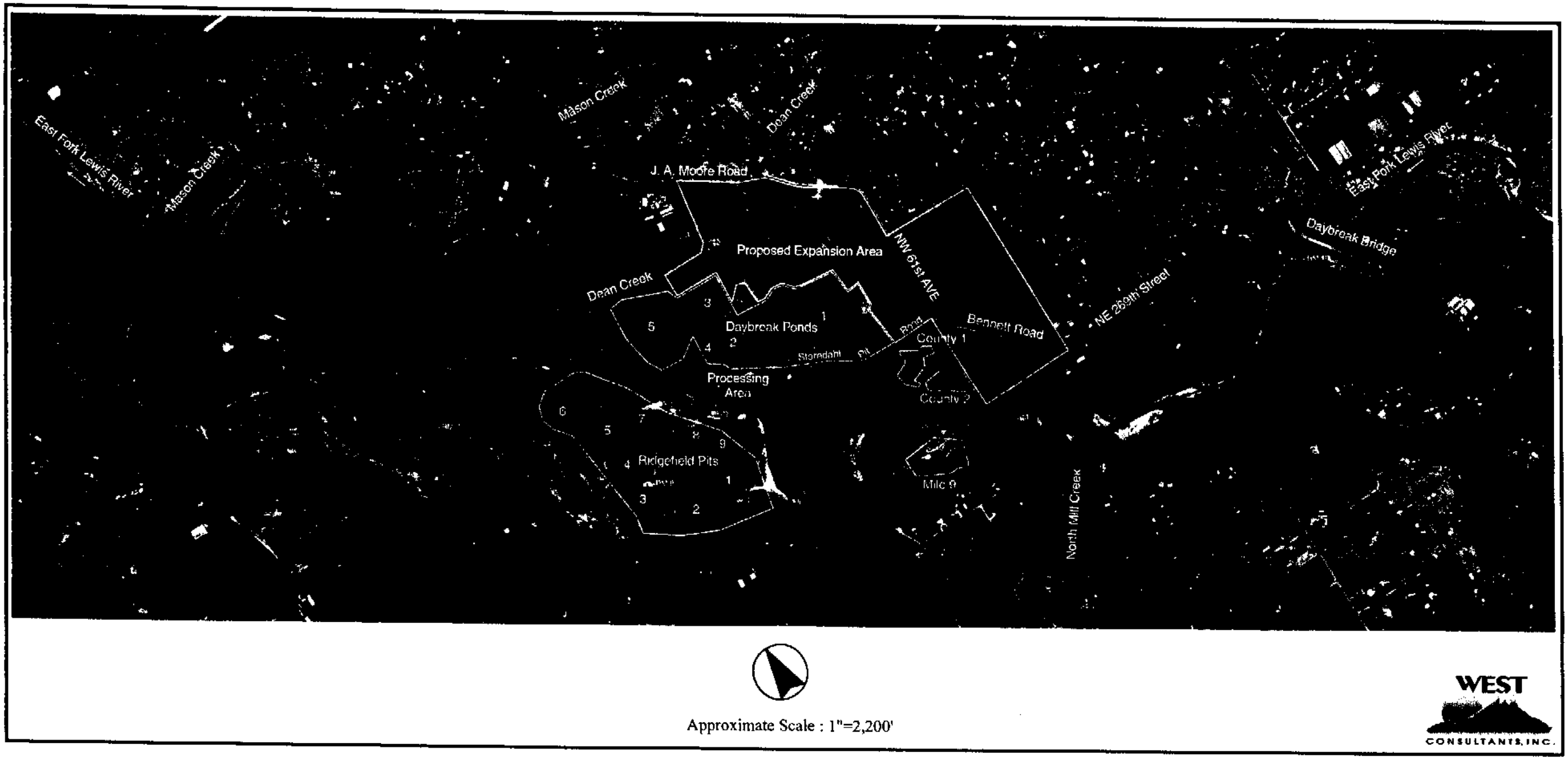


Figure 1-2. Composite Photo of East Fork Lewis River near Daybreak Mine

Expansion of mining activities will extend the surface mine and restoration activities over an additional 178 acres within the approximately 300-acre Daybreak Mine site. Of this area, gravel extraction will occur on approximately 101 acres. The approximate acreages are based on aerial interpretation and have yet to be ground-truthed by surveying. Following reclamation, there will be approximately 64 acres of created open water and 38 acres of forested and emergent wetland in the expanded mining area. The additional 76 acres of property within the178 acres not proposed for mining will be planted to native valley-bottom forest as described in Chapter 4 of the final HCP.

Concurrent with mining and reclamation in the expanded area, the 64 acres of open water in the existing five ponds will be reduced to approximately 38 acres by infilling and creating emergent wetland (4 acres), and forested wetland (22 acres) in place of open water. The remaining 58 acres of the property will be preserved or reclaimed as a mix of native valley-bottom forest and forested wetland.

Lands to be mined are north and east of the existing ponds, and generally further from the East Fork Lewis River than the existing ponds. Five large and several smaller areas will be excavated forming ponds and emergent wetlands. Future mining will be conducted in phases and, as each mining phase ends, mined areas will be sequentially reclaimed according to conservation measures (CM) in the HCP. Areas not proposed for mining will be planted with native valley-bottom forest revegetation, forested wetlands, and emergent wetlands prior to or concurrent with mining. A detailed description of habitat enhancement elements is presented in Chapter 4 of the final HCP.

Covered Activities included in the HCP and ITP include:

- gravel mining and attendant activities outside of the 100-year floodplain (FEMA 2000);
- gravel processing;
- site reclamation activities including, but not limited to, the creation of emergent and open water wetland habitat, narrowing and shallowing of existing ponds, riparian and valley-bottom forest restoration, habitat rehabilitation, riparian irrigation, and low flow augmentation of Dean Creek; and
- implementation, monitoring, and maintenance of all conservation measures in the final HCP.

Action Area

The Action Area consists of approximately 300 acres owned by Storedahl, which includes the following:

- approximately 101 acres affected by proposed gravel mining outside the 100-year floodplain (FEMA 2000);

- approximately 87 acres affected by current gravel processing, haul roads, and the existing ponds; and
- the remaining 112 acres affected by preservation, site reclamation, and rehabilitation.

The Action Area also includes the geographic extent of the adverse effects to covered species as well as all locations where actions will take place to minimize or mitigate the effects of Storedahl's mining and reclamation on the covered species. These locations include the following:

- the mainstem and all side channels of the East Fork Lewis River (inundated at flows less than or equal to the 100-year event), from approximately two mile upstream of the project area (RM 10) downstream to its confluence with the Lewis River; and
- Dean Creek, from J.A. Moore Road to its confluence with the East Fork Lewis River.

Unforeseen Circumstances

The legislative history of the Act addresses the desirability and need to address "unforeseen circumstances" during the term of an incidental take permit; that is, unforeseen circumstances which might jeopardize a listed or threatened species while the permit is in force. However, the uncertainty and unknown cost of dealing with an unforeseen circumstance or an event of unknowable dimensions happening at some unknown time cannot be used to curtail all human activity affecting the environment and/or forestall helpful efforts to protect threatened or endangered species.

Changed Circumstances

This HCP covers Storedahl's operation and habitat enhancement of the Storedahl Daybreak Mine site under ordinary circumstances. In addition, Storedahl and the Services foresee that circumstances could change during the term of this HCP. Changed circumstances mean a change or changes in the circumstances affecting a covered species or the HCP area that can reasonably be anticipated by Storedahl and the Services, and that therefore can reasonably be, and have been, planned for in the HCP. Changed circumstances are different than unforeseen circumstances because they can be anticipated, and can include natural events such as wind damage, catastrophic floods, and channel avulsions. Such changed circumstances are described in this section, along with the measures Storedahl and the Services will implement in response to a changed circumstance. The ITP will authorize the incidental take of covered species under ordinary circumstances as well as these changed circumstances, so long as Storedahl is operating in compliance with the HCP, the ITP, and the IA.

<u>Wind</u>

Wind is an ever-present factor in the HCP area. Daily winds control the climate, growing conditions, and fire danger in the HCP area, while seasonal storms can damage or destroy capital improvements, interrupt electrical power, and uproot trees. In forested portions of the HCP area, wind can create habitat for fish and wildlife by killing live trees and/or toppling trees to create logs or large woody debris (LWD) in streams. Extreme winds can significantly alter habitat, however, by blowing down all or most trees in a given area.

None of Storedahl's CMs would be significantly affected by a temporary loss of electrical power. Temporary local power failures will not prevent Storedahl from fulfilling the mitigation requirements during the term of the HCP. Flow augmentation in Dean Creek is planned by electrical-powered pumping or passive methods. If electric pumps are used, Storedahl will rapidly respond to interruption in power. However, it is unlikely that planted trees and shrubs will reach sufficient height during the HCP term such that a high-wind event would interrupt electrical power and, hence, flow augmentation of Dean Creek.

Trees damaged or toppled by wind will not be removed within the rehabilitated valley-bottom forest, wetland, and riparian management areas. Damaged or toppled trees that could compromise the integrity of the conservation elements would, if necessary, be relocated and used as aquatic or terrestrial habitat enhancement within the HCP area. Storedahl will reforest areas damaged by wind in the valley-bottom forest, wetland, and riparian management areas if Storedahl, and the Services determine reforestation is necessary to protect water quality or achieve the mitigation objectives of the HCP for one or more covered species.

Flood

The existing gravel ponds and portions of the HCP area are within the 100-year floodplain (FEMA 2000) and, therefore, in closer proximity to the East Fork Lewis River. All future mining will be located outside of the 100-year floodplain (FEMA 2000), where it is at less risk of flooding and erosion from flooding. Several CM address the potential affects of flooding, including surface water runoff and erosion control (CM-02), channel avulsion CMs (CM-04, CM-05, CM-06, CM-07, and CM-08), and control of non-native fish (CM-12). Following flood events, each of these measures will be monitored to ensure that they were effective. Adaptive management responses for some of these measures are detailed in Monitoring and Evaluation Measures (MEM) 06 and 07. Other measures such as the creation of an endowment (CM-05) will be unaffected by flooding.

Channel Avulsion

Avulsion is a significant and abrupt change in channel alignment resulting in a new stream or river course. Avulsions can occur during extreme flood events, and their frequency can be increased due to the presence of gravel mines in the floodplain. In recent years, two instances of avulsion in the vicinity of the HCP area have been documented within the channel migration zone. An evaluation of the future avulsion potential near the HCP area identified the most likely locations where an avulsion could occur (Technical Appendix C). Five channel avulsion CMs (CM-04, CM-05, CM-06, CM-07, and CM-08) address this potential for avulsion. Responses to pre- and post-avulsion scenarios will be coordinated with the Services, WDFW, Washington Department of Natural Resources (WDNR), Clark County, and all other appropriate permitting agencies.

Eminent Domain Affecting Lands within the HCP Area

The HCP area is adjacent to private land and lands owned by local government. The land is transected by utility lines and a county road. It is likely one or more parties have the power to acquire or affect lands within the HCP area for the purpose of creating or extending the existing road, public utility, or other public purpose. This could occur through eminent domain, or through voluntary transfer by Storedahl under threat of eminent domain. In the event lands within the HCP area are acquired or affected by any exercise of the power of eminent domain, Storedahl will not be obligated by the HCP or ITP to replace any mitigation provided by such lands. The incidental take coverage for such lands and corresponding HCP obligations may, at the discretion of the Services, be negotiated with and transferred to the recipient of such lands.

Permitting By State and Local Agencies

The HCP may depend on the approval of other federal, state, and/or local permit issuances. Should the project, in whole or substantial part, fail to be implemented due to the failure of other federal, state, or local agencies to issue necessary permits, then Storedahl will, in consultation with the Services, implement those measures that are commensurate with the level of take that occurred as a result of the project and for which Storedahl received incidental take coverage under the permits. If no mining takes place, it is likely that none of the CMs will occur since the project is predicated on mining. If some mining occurs, Storedahl will, in consultation with the Services, implement those measures to account for the mitigation of take that was caused by Storedahl's activities.

Changes in the Status of Covered Species

The FWS may from time to time list additional species under the federal Act as threatened or endangered, de-list species that are currently listed, or declare listed species as extinct. In the event of a change in the federal status of one or more species, the following steps will be taken.

New Listings of Species Covered by the ITP

The ITP will cover four species (sea-run cutthroat, river and Pacific lamprey, and Oregon spotted frog) that currently are not listed as threatened or endangered under the Act. The unlisted species covered by the HCP have been addressed as though they are listed and will appear on the ITP. The ITP will take effect for listed covered species at the time it is issued. Subject to compliance with all other terms of the HCP, the ITP will take effect for any unlisted covered species upon the listing of such species.

New Listings of Species Not Covered by the ITP

If a species that is present or potentially present in the HCP area becomes a candidate for listing, is proposed for listing, is petitioned for listing, or is the subject of an emergency listing under the Act, Storedahl will survey the HCP area to the extent it deems necessary, after coordinating with the Services, to determine whether the species and/or its habitat(s) are present. If survey results indicate the species or its habitat(s) are present in the HCP area, Storedahl will report the results of surveys for the species to the Services. If the Services determine there is a potential for incidental take of the species as a result of Storedahl's otherwise lawful activities, Storedahl may choose to continue to avoid the incidental take of the species, or request the Services to add the newly listed species to the HCP and ITP in accordance with the provisions in the IA and HCP, and in compliance with the provisions of section 10 of the Act. If Storedahl chooses to pursue incidental take coverage for the species by amending this HCP or by preparing a separate HCP, all three parties (Storedahl, FWS, and NOAA Fisheries) will enter into discussions to develop necessary and appropriate mitigation measures to meet section 10(a) requirements in the Act for incidental take coverage. All parties will endeavor to develop mutually acceptable mitigation measures and secure incidental take coverage prior to final listing of the species. Storedahl must implement take avoidance measures until the ITP is issued, if the ITP cannot be secured before listing of the species. In determining adequate mitigation for the species, the Services will give Storedahl full mitigation credit for any and all benefits to the species that have accrued from the time the ITP was signed and the HCP was first implemented, although it is recognized that additional mitigation measures may be necessary to satisfy the requirements of the Act.

De-listings of Species Covered by this HCP

If a species covered by this HCP is de-listed at both the state and federal levels, the FWS and Storedahl will review the mitigation measures being implemented for that species to determine if they are still necessary to protect the species from being re-listed. If continued mitigation by Storedahl is necessary to avoid re-listing the species, mitigation by Storedahl will continue as specified in this HCP. If cessation or modification of the mitigation for that species would not lead to the re-listing of the species, the FWS and Storedahl will revise the HCP to eliminate or otherwise modify the mitigation measures in question. However, if elimination or modification of mitigation measures initially implemented for the species being de-listed would substantially and adversely affect the mitigation benefits for another covered species, the mitigation measures will not be eliminated.

Extinction of Species Covered by this HCP

If a species covered by this HCP becomes extinct, the FWS and Storedahl will review the mitigation measures being implemented for that species to determine if they are still necessary to meet the requirements of the Act for the remaining covered species. If Storedahl and the Services mutually agree that elimination or modification of mitigation measures initially implemented for the extinct species would not materially reduce the mitigation for another covered species, the mitigation measures will be eliminated or modified.

Conservation Measures

Wash Water Clarification Process (CM-01)

During the first three years of the ITP, Storedahl will develop a site-specific, closed-loop clarification system that will effectively eliminate process water discharge. A closed-loop system will remove solids from the process water and re-circulate this water within the closed-loop system. Solids will be removed after they settle out, and a belt press or other suitable system will be used to decrease the water content in the solids. Water from the press will be re-circulated to the treatment system. The final design of the closed-loop system will be developed in consultation with the Services and Washington Department of Ecology (Ecology), and all other appropriate permitting agencies. The closed-loop system will be implemented to treat all process water from mining and processing activities at the Daybreak Mine site as soon as it is approved by the Services and the permitting agencies. Monitoring for this CM will be conducted as described in MEM-01.

Storm Water and Erosion Control Plan and Storm Water Pollution Prevention Plan (CM-02)

A Storm Water Pollution Prevention Plan and a Storm Water Pollution Prevention Plan for Erosion and Sediment Control (SWPPP/ESC) in the HCP will be implemented. The plans that comprise this conservation measure are subject to approval and oversight by Ecology, and are also required components of Storedahl's National Pollution Discharge Elimination System (NPDES) general permit. The complete text of Storedahl's SWPPP/ESC is provided in Technical Appendix D of the HCP. As detailed in the SWPPP/ESC, Storedahl will:

1. sequentially develop and reclaim ponds and create wetlands to minimize the area susceptible to erosion;

2. minimize or potentially eliminate turbid surface water from active mining and reclamation sites from discharging to Dean Creek or the East Fork Lewis River;

3. use created ponds for settling and detention of surface water runoff;

4. implement operational best management practices (BMP) to prevent or reduce water pollution including: use of a conveyor to transport mined aggregate whenever possible; maintain a trained on-site, pollution prevention team; implement preventative maintenance; develop and periodically update a spill prevention and emergency cleanup plan; train employees about the SWPPP/ESC; and inspect on-site erosion and sediment control measures and maintain a log of observations;

5. implement source control BMPs, including temporary and permanent seeding of exposed soils, shaping of slopes above the water to a maximum of 3H:1V slope, and maintenance of appropriate vehicle access road surfacing; and

6. implement structural BMPs including measures to divert flows from exposed soils, store flows, and limit runoff and the discharge of pollutants from exposed areas of the site. This will include the use of silt fences, straw bale barriers, drainage ditches, sediment ponds, and rock outlet protection. Monitoring of these measures will be conducted under MEM-02 in the HCP.

Donation of Water Rights (CM-03)

Contingent on approval of an application for change of water rights by Ecology, 237 acre-feet per year (afy) of water rights on the property will be donated to the State Trust for the enhancement of in-stream flows in the East Fork Lewis River. All water rights associated with the property (330 afy) will be transferred to the State Trust for in-stream flow purposes at the completion of processing operations or the term of the ITP, whichever comes first. Transfer of the water right to the State Trust will be based on the condition that the water is used for in-stream flow purposes only.

Water Management Plan (CM-04)

The discharge of water from Pond 5 will be managed to provide seasonal benefits to Dean Creek. Surface-water discharge between and from the ponds will be controlled by site grading and pond construction (berm construction, outlet elevation, and placement of fine sediments). Surface outflow from Pond 5 will be restricted to a single location and controlled by installation of a gravity-fed outlet structure at the northwest corner of Pond 5. Use of the controlled pond levels and the single release point will direct pond discharge directly to Dean Creek during the fall, winter, and spring. An emergency spillway will be constructed to allow spilling of water from Pond 5 during high-water conditions. The spillway elevation will be set to control outflows from the pond and potential inflows from the East Fork Lewis River during floods less than approximately a 17-year return period.

During warmer months (May through September), the gravity-fed outlet structure will be closed, and an average flow of 0.3 cfs will be pumped from the bottom of Pond 5 or Pond 3 to augment flow in Dean Creek below J.A. Moore Road. The pump will draw cool water from the bottom of the pond and spill the water onto cobbles and boulders to dissipate energy and aerate the water. The location of the discharge to Dean Creek will depend on where summer flow is subsurface and the permeability characteristics of the channel bed. If the temperature of the pond water discharge exceeds the temperature in Dean Creek during the summer, direct discharge to Dean Creek will be stopped and, if necessary, pumping may continue to irrigate the Dean Creek riparian area. Monitoring of these measures will be conducted under MEM-03 in the HCP.

Conservation and Habitat Enhancement Endowment (CM-05)

Storedahl will establish a conservation and habitat enhancement endowment and contribute up to $1,000,000 into the endowment, control of which will be conveyed to a non-profit organization at the completion of the 25-year term of the ITP. The endowment funds would be generated solely by a surcharge of seven cents on each ton of sand and gravel mined from the Daybreak Mine site and sold by Storedahl. The endowment funds will be placed in a dedicated account and will accrue surcharge deposits and earnings or interest. The endowment will be irrevocable. The endowment funds may be used to monitor and, as necessary, adaptively manage the CMs and habitat enhancement on the property following the completion of mining and reclamation activities. Funds within the endowment fund will first be dedicated to habitat monitoring, management, and response to changed circumstances (e.g., avulsion) within the HCP area. The interest and appreciation earned on the endowment fund will also be available to supplement CM-12 (Conservation Easement) at the discretion of the trustee and in consultation with the Services and the Lower Columbia Fish Recovery Board (LCFRB), for enhancement of floodplain ecological functions within the HCP area and the lower East Fork Lewis River basin, which are important to the protection and recovery of the covered species. Contributions and earnings in the fund will be monitored per MEM-10.

Native Valley-Bottom Forest Revegetation (CM-06)

Approximately 134 acres of vegetation typical of early-successional mixed conifer and hardwood forest (106 acres) and forested wetland (28 acres) will be restored. Restoration will occur within the 100-year floodplain (FEMA 2000), along the existing and created ponds, and in the upland areas outside of the 100-year floodplain (FEMA 2000) to increase bank resistance and to provide overbank roughness elements in the vicinity of the Daybreak Mine site. Monitoring of this CM is covered under MEM-05.

Floodplain Reestablishment between Dean Creek and the Phase 6 and 7 Ponds (CM-07)

The floodplain along the eastern bank of Dean Creek will be reestablished through regrading and contouring to create a series of low terraces to provide overbank functions. These terraces will be planted with species typical of the native riparian zone to enhance stability and flow resistance during high flows. Monitoring of this CM is covered under MEM-06.

Mining and Reclamation Designs to Reduce the Risk of an Avulsion and to Ameliorate Negative Effects of Potential Flooding or Avulsion of the East Fork Lewis River into the Daybreak Mine Site (CM-08)

New ponds resulting from future gravel extraction at the Daybreak Mine site will be designed and reclaimed in a manner that enhances site stability and creates potential off-channel habitats in the unlikely event that avulsion should occur. The existing Daybreak Mine ponds will be substantially altered to minimize the potential for avulsion and to avoid or minimize potential adverse environmental impacts that could be associated with an avulsion into a floodplain gravel pit as follows:

1. ponds developed in Phases 3, 4, 5, 6, and 7 will be excavated or reclaimed so that the length exceeds the width and they will be oriented roughly parallel to the East Fork Lewis River;

2. the Phase 1 and 2 excavations will be reclaimed as emergent wetland and valley-bottom forest;

3. the slope of the pond margins will vary from 2:1 to 10:1, with at least 50 percent of the new pond margins shaped to a slope of 5:1 following excavation;

4. the existing Ponds 1, 2, 3, and 4 will be significantly shallowed, narrowed, reshaped, and the shoreline revegetated as emergent wetlands and valley-bottom forest;

5. the buffers between the existing ponds and the river channel and between the existing ponds and the new ponds will be expanded and vegetated; and

6. native valley-bottom forest vegetation will be established on the pond margins and berms left between the ponds to provide shade and enhance bank stability.

Monitoring of this CM is covered under MEM-04, MEM-05, and MEM-07.

Contingency Plan for Potential Avulsion of the East Fork Lewis River into the Existing or Proposed Gravel Ponds (CM-09)

A contingency plan will be implemented to prevent and mitigate for a potential avulsion of the East Fork Lewis River into the gravel ponds on the Daybreak Mine site. Three sites have been identified that represent the most probable future avulsion paths (Sites G, H, and J on Figure 3-33). As a proactive measure to reduce the likelihood of the river shifting to the relict channel adjacent to Site G, Storedahl will designed and initiate bank protection along Storedahl Pit Road and place LWD in rows or debris jams within the floodplain between Site C and the Storedahl Pit Road.

In addition, Sites G, H, and J will be monitored for bank stability conditions, as described in Section 5.3.8 (MEM-08). If target bank stability conditions are exceeded, Storedahl will implement preventative solutions. Solutions may include biotechnical techniques, hydraulic techniques, and/or structural controls. The specific techniques employed will depend on the nature and location of the identified avulsion threat. Preventative solutions will be designed in consultation with Clark County, WDFW, and all appropriate permitting agencies, and approved by the Services prior to construction. Construction activities will be initiated prior to the high flow season (dependent on receipt of all appropriate permits) after the bank stability target conditions are exceeded.

In the event that avulsion of the East Fork Lewis River into the existing or proposed gravel ponds does occur despite preventive actions, mitigation measures will be implemented as part of this CM. These measures include rapid response to:

1. assess the potential of direct take of covered fish species that may be stranded in isolated or shallow water, and coordinate efforts with the Services, the LCFRB, and the WDFW to transfer stranded fish back into the main channel, as appropriate;

2. assess the potential of redirecting flow back into the pre-avulsion channel and the associated benefits to the covered species of this action based on the observed conditions and the results of the Ridgefield Pit Study (CM-10); if the benefits of redirecting the flow are sufficient, engineering solutions will be implemented in consultation with the Services, the LCFRB, and other appropriate agencies;

3. assess the potential of enhancing or restoring lost steelhead and chinook salmon spawning habitat based on the observed conditions and the results of the Ridgefield Pit Study (CM-10) and, if appropriate, implement enhancement or restoration of spawning habitat in consultation with the Services, the LCFRB, and other appropriate agencies; potential actions could include development of a spawning channel in the abandoned reach (if feasible); and

4. modify conservation and monitoring measures that are affected by the avulsion, as appropriate; if avulsion negates or modifies the need for conservation or monitoring measures, then funds for these measures will be redirected to restoration efforts associated with the avulsion event.

Monitoring of this CM is covered under MEM-07.

Study of the Ridgefield Pits and East Fork Lewis River (CM-10)

A study will be initiated to assess the conditions within a recent channel avulsion through the Ridgefield Pits (located south of the Daybreak Mine site) on salmonid habitat in the East Fork Lewis River. Study components will include:

- fish habitat surveys of the East Fork Lewis River between RM 6 and RM 13;
- observations of fish use in the East Fork Lewis River between RM 6 and RM 13;
- monitoring of temperature and dissolved oxygen in the avulsed reach;
- assessment of channel shape, pool volume, and sediment infill rates; and
- participation in and assessment of planned habitat restoration efforts.

Off-Site Floodplain Enhancement (CM-11)

Labor, equipment, and/or materials will be provided to public and private non-profit groups chosen by the LCFRB and Storedahl, to enhance floodplain functions related to protection and recovery of the covered species within the East Fork Lewis River basin in locations outside of Storedahl's Daybreak Mine property boundaries.

Storedahl will donate in-kind services (materials, equipment, and/or labor) up to $25,000 per year beginning in the third year of the ITP through year 12 of the ITP for a total value of $250,000. This is in addition to the $1,000,000 conservation endowment (CM-05). The donated services must be used each or every other year, so that total value of services provided in any year does not exceed $50,000. The timely use of the labor and/or services will be guaranteed by providing the services to projects that are nominated to Storedahl by the LCFRB for use on projects to benefit ongoing recovery efforts in the lower East Fork Lewis River basin. Project sponsors will be responsible for permitting, and access and easement agreements.

Conservation Easement and Fee-Simple Transfer (CM-12)

Following issuance of the ITP and prior to the commencement of any active mining (removal of raw sand and gravel) on the Daybreak Mine lands, Storedahl will grant a perpetual conservation easement for a portion of the Daybreak Mine lands to a conservation organization or a government entity approved by the Services. The conservation easement will be in the form set forth in Appendix F (Implementing Agreement), and will apply to the portions of the Daybreak Mine property not proposed for mining, comprising approximately 19 acres, as more fully described in Appendix H. The easement will prohibit subdivision, commercial or industrial activity, motorized recreation, and any other activities that are inconsistent with protection and recovery of the covered species.

Within 60 days following completion of reclamation on the remainder of the Daybreak Mine property as set forth in this HCP, Storedahl will, without further consideration, convey fee title to the property to one or more conservation organizations or government entities approved by the Services. Such conveyance may be made in one or more transactions and will encompass the entire Daybreak Mine property (comprising approximately 300 acres as described in Addendum 1 of the IA) following completion of all reclamation, or in a series of transactions involving smaller parcels, as reclamation is completed on such parcels, provided that the entire Daybreak Mine property ultimately is so conveyed. Storedahl will ensure, at the time of such conveyance, that the property will be preserved as fish and wildlife habitat in perpetuity, either by means of a conservation easement acceptable to the Services, as described above, or through such other means as the Services may approve at that time. Following fee simple transfer of the property and granting of the endowment but no later than the completion of the 25-year term of the ITP, the Conservation and Habitat Enhancement Endowment provided for in CM-05 will be available for management of the property conveyed under this measure. However, if Storedahl, for reasons beyond its control, is unable to conduct mining activity as anticipated under this HCP, Storedahl will not convey a conservation easement with respect to such lands nor will such lands be conveyed in fee title, as noted above.

Riparian Management Zone on Dean Creek (CM-13)

A two-zone, 200-foot management area along the left bank (facing downstream) of Dean Creek will be established. The inner zone will be a minimum of 75 feet in width. No excavation for mineral resources will occur in the inner zone. The inner zone will be regraded to create a series of low terraces upwards from the ordinary high water mark to reduce or eliminate the likelihood that Dean Creek would avulse into the Daybreak Mine ponds (CM-07). Existing native shrubs and trees in the inner zone will be retained, where appropriate, and the entire 75-foot inner zone will be revegetated as native valley-bottom forest (CM-06) or streambank vegetation (CM-14). The inner management zone is designed primarily to enhance channel habitat and protect Dean Creek during Phase 1 mining impacts. Following Phase 1A and 1B mining in the area adjacent to the inner management zone, the outer management zone of a minimum 125 feet will be filled with imported and/or processing by-product material and then revegetated as native valley-bottom vegetation (as per CM-06) within 5 years of issuance/implementation of the ITP. Upon revegetating the inner and outer zone, no disturbance or heavy equipment operation will be allowed in the entire 200-foot riparian management zone along the left bank of Dean Creek. The two-zone riparian management area will protect Dean Creek from short-term impacts and will provide a wide array of long-term riparian functions that will contribute to improved salmonid habitat in Dean Creek. Monitoring of this CM will be covered under MEM-06.

In-Channel Habitat Enhancement in Select Reaches of Dean Creek (CM-14)

Following reestablishment of floodplain terraces on the east bank under CM-07, habitat in Dean Creek will be re-surveyed and LWD will be added to the pool-riffle reach downstream of the J.A. Moore Road and upstream of the palustrine channel in the downstream reach. Designs for site-specific log placements will be developed by year 6 following issuance of the ITP and other required permits (5 years after reestablishment of the floodplain terraces), which will allow riparian vegetation sufficient time to develop root systems that will resist lateral scour. Site-specific designs will be developed to improve low-flow habitat quality by enhancing pool scour and to improve winter rearing habitat by increasing cover in pools. In-channel log structures will consist of key pieces of conifer logs that are at least 88 ft^3 in volume (e.g., 22-inches diameter and 30-feet long) at a frequency of > 1 piece per 72 feet of channel. A plan with details on site-specific log placements will be submitted to the Services and WDFW for review and approval, as necessary, prior to implementation. Monitoring of this CM will be covered under MEM-06.

Shallow Water and Wetlands Habitat Creation (CM-15)

Approximately 84 acres of wetlands, including forested wetland (52 acres) and emergent wetlands (32 acres), will be created and preserved on the Daybreak Mine site. Along the wetted edges and in the shallow water, structural elements will be incorporated into the ponds to provide substrate and cover for a variety of organisms, including invertebrates, amphibians, and fish. The structural elements will consist of submerged tree crowns that are 20- to 30-feet long and will be placed along the submerged sloping perimeter of the ponds. The tree crowns will be anchored with rocks to keep them in place and prevent flotation to the surface. Average frequency of placement will be approximately one per 100 feet of shoreline, although the spacing will be irregular. Monitoring of this CM will be covered under MEM-04.

Control of Non-Native Predatory Fishes (CM-16)

The frequency of backwater flood flows from the East Fork Lewis River into Pond 5 will be reduced by reconfiguring the southern and western berms around Pond 5 and by installing a single outlet point from Pond 5 for surface water (CM-04, Water Management Plan). Concurrently, the quantity of existing and potential habitat available to non-native predatory fishes in the existing Daybreak Mine ponds will be reduced by significantly narrowing Ponds 1, 2, 3, and 4 (CM-08, Mining and Reclamation Designs). Targeted harvests of non-native predatory fishes to reduce their numbers in the existing ponds will occur under direction of WDFW warmwater fish biologists in years 5, 10, and 15 following issuance/implementation of the ITP and the issuance of other required permits. Rock barriers will be installed to restrict movement of fish between the existing and created ponds. Educational signs will be installed to warn the public about the dangers of releasing non-native fish species to the ponds and the adjacent stream and river. Monitoring of this CM will be covered under MEM-08.

Creation of Oregon Spotted Frog Habitat (CM-17)

If the presence of this species in Clark County is verified by WDFW, surveys of the Daybreak Mine site for Oregon spotted frogs will be conducted. If this covered species is present on the site, potential take will be minimized by installation of exclusion fences to restrict breeding frogs from entering areas where mining and reclamation activities are taking place, and by seasonally timing the mining and reclamation activities (to the maximum extent possible) to avoid negatively impacting breeding spotted frogs. Monitoring of this CM will be covered under MEM-09.

Controlled Public Access (CM-18)

Public access to the site will be controlled by the decommissioning of unnecessary roads, placement of vehicle barriers, and development of foot trails. These actions will minimize destructive or injurious vehicle and foot traffic on riparian habitats and limit access to habitats that support covered species. During the operational phase of the mining and processing, on-site security agents will be instructed to restrict trespassing in sensitive areas when such areas are present.

Monitoring and Evaluation Measures

Clarification and Process Monitoring (MEM-01)

Storedahl will continue to monitor the effects of chemical additives on water quality and aquatic organisms. While the existing process water treatment system is in operation (estimated to be the first one to three years of the ITP), monitoring will occur at the outlet from Pond 1 to Pond 2 and at the outlet from Pond 3 to Pond 5. The results of this monitoring will be thoroughly evaluated one year after the implementation of the ITP to assess the effectiveness of CM-01. During the first year of operation under the ITP, Storedahl will develop a detailed monitoring plan to assess the effectiveness and potential toxicity of a closed-loop clarification system. Final elements of the new monitoring plan will be subject to approval by the Services and Ecology prior to implementation of the closed-loop system. Extensive monitoring during the operation of the current system has been completed regarding the effectiveness and potential toxicity of the existing system. The results of this monitoring have been reported to Ecology (Sweet *et al.* 2003, Appendix G).

Following approval and implementation of a closed-loop treatment system, the release of process water to the Daybreak Mine ponds will be substantially reduced or eliminated. Incidental release of water during maintenance or during normal operations will be rerouted back to the closed-loop system for reuse. Wet processing would be halted if repair, maintenance, or replacement of the closed-loop system is needed. Operational monitoring will be performed on the closed-loop system to determine the minimum amount of additives needed to remove suspended solids from the process water. Bioassays to determine potential toxicity and bioaccumulation will be performed on the removed and dewatered solids using standard U.S. Environmental Protection Agency methods (USEPA 2000).

Quarterly monitoring reports on the closed-loop system will be submitted to Ecology and the Services. The reports will contain the quantities of additive used and a data summary, which will report values for monitoring parameters. Copies of the test results, sampling logs, chain-of-custody forms, analytical reports, and lab quality assurance and control reports will be maintained by Storedahl for at least five years from the date of sample collection and, upon request, will be made available to the Services.

NPDES Monitoring (MEM-02)

Storedahl will monitor turbidity, total suspended solids, and pH of the water discharged from the Daybreak Mine site. This monitoring is required per a specific schedule for the Daybreak Mine site per the NPDES permit, which is a general permit covering surface mining activities in the State of Washington. Discharge will be monitored at the outlet of Pond 3 to Pond 5. To be in compliance with its NPDES permit, discharge from Pond 3 must have turbidity < 50 nephelometric turbidity units (NTU), total suspended solids < 40 mg/l, and pH between 6.0 and 9.0. Although the NPDES permit allows the release of water with turbidity near 50 NTU, Storedahl will maintain turbidity at the Pond 3 outlet to Pond 5 to below 25 NTU, as specified under CM-01. The NPDES monitoring results are reported quarterly to Ecology. Copies of the reports will be provided to the Services and results will be summarized at 5-year reviews. Monitoring for NPDES permit compliance will continue throughout the period of on-site mining or processing. In addition, Storedahl will monitor summer ground water temperatures at Piezometer 3 down gradient from Pond 5. This additional monitoring will coincide with summer NPDES monitoring of surface water temperatures in the ponds.

Water Management Plan Monitoring (MEM-03)

Storedahl will monitor temperature and dissolved oxygen (DO) of the water discharged at the outlet of Pond 5 from the pumped-intake system, and in Dean Creek just upstream of the Pond 5 outlet. Monitoring will be conducted daily during the months of May through September, when high temperatures are most likely to adversely affect fish. Outflow water will be taken from cooler, deeper portions of the ponds if the pond surface temperature exceeds the temperature in Dean Creek. If cooler water is unavailable, discharge at the outlet will be prevented, or discharge from the pumped-intake system will be released for riparian irrigation and it will not be released directly to Dean Creek. Pond levels and discharge will meet flow objectives outlined in the water management plan.

Pond, Shallow Water, and Shoreline Physical Structure Monitoring (MEM-04)

Storedahl will conduct as-built topographic and bathymetric surveys following reclamation of the new ponds and wetlands to document that the CM and project design criteria were met with respect to depth, slope, location, and habitat features. Surveys will be conducted within six months following reclamation of each pond. Additionally, wetland areas will be examined five years post-reclamation to evaluate the stability of the wetland substrate material. Criteria to be met include establishing approximately 32 acres of emergent wetland habitat and installation of structural habitat elements within the ponds, as specified in the reclamation plan. Monitoring the success of revegetation is addressed under MEM-06. Monitoring fish use and water quality is described in MEM-08.

Vegetation Monitoring (MEM-05)

Storedahl will monitor all revegetated areas to evaluate the success of plant establishment from seeding and planting. Monitoring will evaluate plant cover, canopy closure, vigor, species composition, and levels of herbivore damage. The presence and extent of non-native plant species will be noted. If successful establishment and growth of desired plants is retarded, soil moisture, nutrient status, and pond water level fluctuations will also be monitored to aid in identifying any physical factors that might be retarding the establishment and growth of desired plants. Monitoring of vegetation characteristics and soil nutrients will take place annually during the growing season for three years following revegetation and every five years thereafter. Soil moisture will be monitored monthly during the growing season (April to September) for three years following revegetation. Results of vegetation monitoring will be evaluated according to criteria listed in Table 5-1. Monitoring of riparian vegetation along Dean Creek is addressed in MEM-07.

Dean Creek Riparian and Channel Condition Monitoring (MEM-06)

Storedahl will conduct stream channel surveys to monitor conditions in and along Dean Creek from the Pond 5 outlet upstream to J.A. Moore Road. Baseline conditions were documented during a habitat survey in August 1999. Preliminary locations requiring structural treatment to reestablish bank stability were identified, and it was determined that stabilization of banks should be completed prior to rehabilitation of in-channel habitats. Following construction of floodplain terraces, structural treatment of unstable banks, clearing of non-native vegetation, and planting of the riparian buffer, surveys of canopy cover will be conducted to document baseline shade conditions. Canopy cover will be measured at 100-foot intervals using a densiometer. Surveys of canopy cover will be repeated at 5-year intervals for the duration of the ITP, and results will be reported at 5-year reviews.

Channel condition/habitat surveys will be conducted one, two, and five years after planting and treatments of unstable banks are completed. Surveys will also be conducted following regional flood events with a return interval equal to or greater than 10 years (i.e., flows of 15,000 cfs at the Heisson United States Geological Service gage). In the fifth year following completion of bank rehabilitation activities, habitat rehabilitation plans will be developed for the pool-riffle reach downstream of the J.A. Moore Road crossing. Following completion of prescribed habitat restoration activities, a post-construction survey will be conducted to document adherence to site-specific designs. Follow-up surveys of channel conditions and habitat will be completed one, two, and five years after rehabilitation prescriptions are implemented, and following regional flood events with a return interval equal to or greater than 10 years (i.e., flows of 15,000 cfs at the Heisson United States Geological Service gage). LWD that has decayed or moved to a position that no longer contributes to habitat function will be replaced once over the term of ITP.

East Fork Lewis River Channel Bank Stability Monitoring (MEM-07)

Bank stability will be monitored at Sites G, H, and J (Figure 3-33). At Site G, the proportion of total flow transmitted by the relict channel south of the Storedahl Pit Road, and erosion associated with flows through that channel, will be measured using a combination of surveyed cross-sections and visual observation during normal winter high flows. If the surveys indicate that the relict channel has migrated or enlarged to the point that the distance between the north bank and the access road is less than or equal to twice the average annual rate of channel migration (2 times 40 feet), or if visual observations indicate that the relict channel consistently transmits more than approximately 40 percent of the East Fork Lewis River discharge, Storedahl will notify the Services. Storedahl will coordinate and consult with the Services, LCFRB, WDFW, Clark County, and all appropriate permitting agencies to develop engineering solutions designed to prevent a breach of the Storedahl Pit Road as described in CM-09 (Avulsion Contingency Plan).

Storedahl will conduct annual monitoring of bank stability at Sites H and J. Should the river reoccupy its former channel, or if visual observations suggest that bank erosion has increased at Site H or J, the monitoring approach and frequency will be modified in consultation with the Services. If the estimated erosion rate observed during normal high flows (approximately 9,000 cfs at the Heisson gage) suggests that a breach into the Daybreak Mine ponds is possible within less than 2 years (i.e., distance between bank and ponds becomes less than 2 times the observed erosion rate), Storedahl will implement preventative solutions to reduce the likelihood of pond capture. Specific engineering solutions and final designs will be developed in consultation with the Services, LCFRB, WDFW, and Clark County in consideration of all appropriate permitting requirements.

Pond Fish Use and Limnology Monitoring (MEM-08)

Storedahl will monitor fish communities and water quality characteristics that control fish use in the created ponds and in the existing Pond 5. Water quality attributes to be measured include transparency, temperature, pH, and DO. Transparency in the ponds will be measured by secchi depth, a standard and rapid measure of light penetration in surface waters. Temperature, pH, and DO will be measured along depth profiles from the surface to the bottom near the deepest point of each pond.

Transparency and depth profiles in Pond 5 will be conducted monthly from April through September for the first three years of the HCP. In the newly excavated ponds, monitoring of transparency and depth profiles will be conducted from April through September during the first three years following reclamation.

The fish community in Pond 5 will be monitored following completion of CM-04 (Water Management Plan), which will reconfigure the western berm and outlet of Pond 5, and prior to and following targeted removal of largemouth bass. A variety of fish sampling techniques will be used including, but not limited to, underwater observation, minnow traps, gill nets, electrofishing, and angling. Prior to fish sampling, all necessary state and federal permits will be obtained.

Oregon Spotted Frog Monitoring (MEM-09)

If WDFW confirms that Oregon spotted frogs have been found in Clark County, Storedahl will monitor for the presence of Oregon spotted frogs at the existing ponds, excavation sites, and ponds scheduled for reclamation. The presence of Oregon spotted frogs will be surveyed using basic survey techniques described by Olson *et al.* (1997). Two surveys will be conducted for three years following a confirmation of the species presence in Clark County. The first survey will occur in February, preferably following a warm rain event or when air temperatures have exceeded 10°C (50°F). The second survey will occur approximately two weeks, but no more than 4 weeks, later. Surveys will focus on the northern edge of each existing pond and cover the shallow water zone and shoreline within 3 meters of the waterline. If spotted frogs are positively identified at the site, Storedahl will develop an ongoing monitoring plan and implement protection measures for Oregon spotted frogs, in consultation with the FWS.

Financial Status of Conservation Endowment (MEM-10)

Storedahl will submit annual (year-end) financial records from the dedicated interest-bearing, or managed, account established for the Conservation and Habitat Enhancement Endowment (CM-05). A surcharge of seven cents will be added to the cost of the aggregate, and deposited monthly into this account for every ton of sand and gravel mined from the Daybreak Mine site and sold by Storedahl. If monies are not placed in the account from the sale of sand and gravel mined from the site in a timely manner, the Services may rescind the ITP.

STATUS OF THE SPECIES

Bull Trout (Columbia Basin DPS)

On November 1, 1999, the FWS (USDI 1999) listed five distinct populations segments (DPS) of the bull trout within the coterminous United States as threatened. These 5 DPS, with 187 subpopulations, include: 1) the Coastal-Puget Sound DPS, with 34 subpopulations; 2) the Columbia River DPS, with 141 subpopulations ; 3) the Jarbidge River DPS, with 1 subpopulation; 4) the St. Mary-Belly River DPS, with 4 subpopulations; and 5) the Klamath River DPS, with 7 subpopulations. Factors contributing to the decline of bull trout populations were identified in the listing rule and include restriction of migratory routes by dams and other unnatural barriers; forest management, grazing, and agricultural practices; road construction; mining; introduction of non-native species; and residential development resulting in adverse habitat modification, over-harvest, and poaching (Bond 1992; Thomas 1992; Rieman and McIntyre 1993; Donald and Alger 1993; WDFW 1997). Critical habitat has been proposed only for the Columbia River and Klamath River DPS.

In recognition of the scientific basis for the identification of bull trout DPS i.e., each DPS is unique and significant, the final listing rule specifies that these DPS will serve as interim recovery units for the purposes of consultation and recovery planning until an approved recovery plan is completed. On that basis, the geographic scope of jeopardy analyses for actions under formal consultation will be at the DPS level as opposed to the entire coterminous United States range of bull trout. This Opinion will evaluate the effect of the proposed action on the Columbia River DPS of bull trout. The Lewis River subpopulation(s) will be specifically addressed in this Opinion.

The FWS developed a draft recovery plan for the Columbia River (USFWS 2002) and is currently developing the recovery plan for the Coastal-Puget Sound DPS. The bull trout recovery planning efforts are converting bull trout subpopulations into "core areas" (USFWS 2002). Core area is defined as the combination of core habitat i.e., habitat that could supply all elements for the long-term security of bull trout and a core population (a group of one or more local bull trout populations that exist within core habitat), which constitutes the basic unit on which to gauge recovery. Core areas require both habitat and bull trout to function, and represents the closest approximation of a biologically functioning unit for bull trout.

In general, core areas meet a set of criteria proposed by Rieman and McIntrye (1993) (see Lohr *et al.* 2001) and have been expanded, by the bull trout recovery planning team, to focus on restoration of conditions and activities that may be necessary for recovery. The 141 subpopulations within the Columbia River DPS are being converted into 88 core areas.

Life History

Bull trout are a member of the char family and closely resemble another member of the char family, Dolly Varden (*Salvelinus malma*). Genetics indicate, however, that bull trout are more closely related to an Asian char (*Salvelinus leucomaenis*) than to Dolly Varden (Pleyte, *et al.* 1992). Bull trout are sympatric with Dolly Varden over part of their range, most notably in British Columbia and the Coastal-Puget Sound region of Washington state.

Bull trout distribution has been reduced by an estimated 55 percent in the Klamath River DPS and 79 percent in the Columbia River DPS since pre-settlement times, due primarily to local extirpations, habitat degradation, and isolating factors (Quigley and Arbelride 1997). Within the Coastal-Puget Sound DPS, bull trout distribution is similar to historic distributions, but population abundance has significantly decreased in some portions of this range (USDI 1999). Bull trout historically occurred in major river drainages in the Pacific Northwest, extending from northern California to the headwaters of the Yukon River in the Northwestern Territories of Canada (Cavender 1978; Bond 1992). In California, bull trout were historically found only in the McCloud River, which represented the southernmost extension of the species' range. The last confirmed report of this species in the McCloud River was in 1975, and the original population is now considered to be extirpated (Rode 1990). The remaining distribution of bull trout is highly fragmented.

Bull trout currently occur in rivers and tributaries in Montana, Idaho, Washington, Oregon (including the Klamath River basin), Nevada, two Canadian Provinces (British Columbia and Alberta), and several cross-boundary drainages in extreme southeast Alaska. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta, and the McKenzie River system in Alberta and British Columbia (Cavender 1978; McPhail and Baxter 1996; Brewin and Brewin 1997).

Bull trout populations exhibit four distinct life history types: resident, fluvial, adfluvial, and anadromous. Fluvial, adfluvial, and resident forms exist throughout the range of the bull trout (Rieman and McIntyre 1993) and spend their entire life in freshwater. The only known anadromous life history form within the coterminous United States occurs in the Coastal-Puget Sound region (Volk, 2000; Kraemer 1994; Mongillo 1993). Highly migratory populations have been eliminated from many of the largest, most productive river systems across their range. Many "resident" bull trout presently exist as isolated remnant populations in the headwaters of rivers that once supported larger, more fecund migratory forms. These remnant populations lacking connectivity to migratory populations have a low likelihood of persistence (Rieman and McIntyre 1993; Rieman and Allendorf 2001).

The majority of the growth and maturation of anadromous bull trout occurs in estuarine and marine waters; for adfluvial bull trout, the major growth and maturation occurs in lakes or reservoirs; and for fluvial bull trout, the major growth and maturation occurs in large river systems. Resident bull trout populations are generally found in small headwater streams where the fish tend to spend their entire lives. These diverse life history types are important to the stability and viability of bull trout populations (Rieman and McIntyre 1993).

For all life history types, the juveniles tend to rear in tributary streams for 1 to 3 years before migrating downstream into a larger river, lake, or estuary and/or nearshore marine area to mature (Rieman and McIntyre 1993). In some lake systems, age 0+ fish may migrate directly to lakes (Riehle *et al.* 1997). Juvenile and adult bull trout frequently inhabit side channels, stream margins and pools with suitable cover (Sexauer and James 1993) and areas with cold hyporheic zones or groundwater upwellings (Baxter and Hauer 2000).

Bull trout become sexually mature between 4 and 9 years of age, and may spawn in consecutive or alternate years (Shepard *et al.* 1984; Pratt 1992). Spawning typically occurs from August through December in cold, low-gradient 1st- to 5th-order tributary streams, over loosely compacted gravel and cobble having groundwater inflow (Shepard *et al.* 1984, Brown 1992, Rieman and McIntyre 1996, Swanberg 1997, MBTSG 1998, Baxter and Hauer 2000). Spawning sites frequently occur near cover (Brown 1992). Migratory bull trout may begin their spawning migrations as early as April and have been known to migrate upstream as far as 250 kilometers (155 miles) to spawning grounds (Fraley and Shepard 1989). Hatching occurs in winter or early spring, and alevins may stay in the gravel for up to three weeks before emerging from the gravel. The total time from egg deposition to fry emergence from the gravel may exceed 220 days. Post-spawning mortality, longevity, and repeat-spawning frequency are not well known (Rieman and McIntyre 1996), but lifespan may exceed 10-13 years (McPhail and Murray 1979, Pratt 1992, Rieman and McIntyre 1993).

Bull trout are apex predators, and require a large prey base and home range. Adult and subadult migratory bull trout are primarily piscivorous, feeding on various trout and salmon species, whitefish, yellow perch (*Perca flavescens*), and sculpin. Subadult and adult migratory bull trout move throughout and between basins in search of prey. Anadromous bull trout in the Coastal-Puget Sound DPS also feed on ocean fish such as surf smelt (*Hypomesus pretiosus*) and sandlance (*Ammodytes hexapterus*). Resident and juvenile bull trout prey on terrestrial and aquatic insects, macrozooplankton, amphipods, mysids, crayfish, and small fish (Wyman 1975, Rieman and McIntyre 1993, Boag 1987, Goetz 1989, Donald and Alger 1993). A recent study in the Cedar River Watershed of western Washington found bull trout diets to also consist of aquatic insects, crayfish, and salamanders (Connor *et al.* 1997).

Habitat Requirements

Bull trout have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Growth, survival, and long-term persistence are dependent upon the following habitat characteristics: cold water, complex instream habitat, stable substrate with a low percentage of fine sediments, high channel stability, and stream/population connectivity. Stream temperature and substrate type, in particular, are critical factors for the sustained long-term persistence of bull trout. Spawning is often associated with the coldest, cleanest, and most complex stream reaches within basins. However, bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1995), and should not be expected to occupy all available habitats at the same time (Rieman *et al.* 1997).

While bull trout clearly prefer cold waters and nearly pristine habitat, it cannot be assumed that they do not occur in streams where habitat is degraded. Given the depressed status of some subpopulations, it is likely that individuals in degraded rivers are utilizing less than optimal habitat because that may be all that is available. In basins with high productivity, such as the Skagit River basin, bull trout may be using marginal areas when optimal habitat becomes fully occupied. Bull trout have been documented using habitats that may be atypical or characterized as likely to be unsuitable (USFWS 2000).

Temperature

For long-term persistence, bull trout populations need a stream temperature regime that ensures sufficient amounts of cold water are present at the locations and during the times needed to complete their life cycle. Temperature is most frequently recognized as the factor limiting bull trout distribution (Dunham and Chandler 2001, Rieman and McIntyre 1993). Probability of occurrence for juvenile bull trout in Washington is relatively high (75%) when maximum daily temperatures did not exceed approximately 11- 12° C (Dunham *et al.* 2001). Water temperature also seems to be an important factor in determining early survival, with cold water temperatures resulting in higher egg survival and faster growth rates for fry and juveniles (Pratt 1992). Optimum incubation temperatures range from 2° to 6° C. At 8° C to 10° C, survival ranged from 0-20 percent (McPhail and Murray 1979). Stream temperatures for tributary rearing juvenile bull trout are also quite low, ranging from 6° to 10° C (Buchanan and Gregory 1997, Goetz 1989, Pratt 1992, McPhail and Murray 1979).

Increases in stream temperatures can cause direct mortality, increased susceptibility to disease or other sublethal effects, displacement by avoidance (McCullough *et al.* 2001, Bonneau and Scarnechia 1996), or increased competition with species more tolerant of warm stream temperatures (Rieman and McIntyre 1993, Craig and Wissmar 1993 cited in USDI (1997), MBTSG 1998). Brook trout, which can hybridize with bull trout, may be more competitive than bull trout and displace them, especially in degraded drainages containing fine sediment and higher water temperatures (Clancy 1993, Leary *et al.* 1993). Recent laboratory studies suggest bull trout are at a particular competitive disadvantage in competition with brook trout at temperatures >12° C (McMahon *et al.* 2001).

Although bull trout require a narrow range of cold water temperatures to rear, migrate, and reproduce, they are known to occur in larger, warmer river systems that may cool seasonally, and which provide important migratory corridors and forage bases. For migratory corridors, bull trout typically prefer water temperatures ranging between 10° - 12° C (McPhail and Murray 1979, Buchanan and Gregory 1997). When bull trout migrate through stream segments with higher water temperatures they tend to seek areas offering thermal refuge such as confluences with cold tributaries (Swanberg 1997), deep pools, or locations with surface and groundwater exchanges in alluvial hyporheic zones (Frissell 1999). Water temperatures above 15° C are believed to limit bull trout distribution, which partially explains their generally patchy distribution within a watershed (Fraley and Shepard 1989, Rieman and McIntyre 1995).

Substrate

Bull trout show a strong affinity for stream bottoms and a preference for deep pools in cold water streams (Goetz 1989, Pratt 1992). Stream bottom and substrate composition are highly important for juvenile rearing and spawning site selection (Rieman and McIntyre 1993, Graham *et al.* 1981, McPhail and Murray 1979). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985, Pratt 1992) but might also limit access to substrate interstices that are important cover during rearing and over-wintering (Goetz 1994, Jakober 1995). Rearing densities of juvenile bull trout have been shown to be lower when there are higher percentages of fine sediment in the substrate (Shepard *et al.* 1984). Due to this close connection to substrate, bed load movements and channel instability can negatively influence the survival of young bull trout.

Cover and Stream Complexity

Bull trout of all age classes are closely associated with cover, especially during the day (Baxter and McPhail1997, Fraley and Shepard 1989). Cover may be in the form of overhanging banks, deep pools, turbulence, large wood, or debris jams. Young bull trout use interstitial spaces in the substrate for cover and are closely associated with the streambed. This association appears to be more important for bull trout than for other salmonid species (Pratt 1992, Rieman and McIntyre 1993).

Bull trout distribution and abundance is positively correlated with pools and complex forms of cover, such as large or complex woody debris and undercut banks, but may also include coarse substrates (cobble and boulder) (Rieman and McIntyre 1993, Jakober 1995, MBTSG 1998). Studies conducted with Dolly Varden showed that population density declined with the loss of woody debris after clearcutting or the removal of logging debris from streams (Bryant 1983, Dolloff 1986, Elliott 1986, Murphy *et al.* 1986).

Large pools, consisting of a wide range of water depths, velocities, substrates, and cover, are characteristic of high quality aquatic habitat and an important component of channel complexity.

Reduction of wood in stream channels, either from present or past activities, generally reduces pool frequency, quality, and channel complexity (Bisson *et al.* 1987, House and Boehne 1987, Spence *et al.* 1996). Large wood in streams enhances the quality of habitat for salmonids and contributes to channel stability (Bisson *et al.* 1987). It creates pools and undercut banks, deflects streamflow, retains sediment, stabilizes the stream channel, increases hydraulic complexity, and improves feeding opportunities (Murphy 1995). By forming pools and retaining sediment, large wood also helps maintain water levels in small streams during periods of low stream flow (Lisle 1986).

Channel and Hydrologic Stability

Due to the bull trout's close association to the substrate, bed load movements and channel instability can reduce the survival of young bull trout. Maintaining bull trout habitat requires stream channel and flow stability (Rieman and McIntyre 1993). Bull trout are exceptionally sensitive to activities that directly or indirectly affect stream channel integrity. Juvenile and adult bull trout frequently inhabit areas of reduced water velocity, such as side channels, stream margins, and pools that are easily eliminated or degraded by management activities (Rieman and McIntyre 1993). Channel dewatering caused by low flows and bed aggradation has blocked access for spawning fish resulting in year class failures (Weaver 1992). Timber harvest and the associated roads may cause landslides that affect many miles of stream through aggradation of the streambed.

Patterns of stream flow and the frequency of extreme flow events that influence substrates may be important factors in population dynamics (Rieman and McIntyre 1993). With lengthy overwinter incubation and a close tie to the substrate, embryos and juveniles may be particularly vulnerable to flooding and channel scour associated with the rain-on-snow events that are common in some parts of the range (Rieman and McIntyre 1993). Surface/groundwater interaction zones, which are typically selected by bull trout for redd construction, are increasingly recognized as having high dissolved oxygen, constant cold water temperatures, and increased macro-invertebrate production.

Migration

The persistence of migratory bull trout populations requires maintaining migration corridors. Stream habitat alterations that restrict or eliminate bull trout migrations corridors include degradation of water quality (especially increasing temperatures and increased amounts of fine sediments), alteration of natural stream flow patterns, impassable barriers (such as dams and culverts), and structural modification of stream habitat (such as channelization or removal of cover). In the Coastal-Puget Sound DPS, migratory corridors may link seasonal marine and freshwater habitats as well as linking lake, river and tributary complexes that are necessary for bull trout to complete their life history requirements.

The importance of maintaining the migratory life history form of bull trout, as well as migratory runs of other salmonids that may provide a forage base for bull trout, is repeatedly emphasized in the scientific literature (Rieman and McIntyre 1993, MBTSG 1998, Dunham and Rieman 1999, Nelson *et al.* 2002). Isolation and habitat fragmentation resulting from migratory barriers have negatively affected bull trout by: (1) reducing geographical distribution (Rieman and McIntyre 1993, MBTSG 1998); (2) increasing the probability of losing individual local populations (Rieman and McIntyre 1993, MBTSG 1998, Nelson *et al.* 2002, Dunham and Rieman 1999); (3) increasing the probability of hybridization with introduced brook trout (Rieman and McIntyre 1993); (4) reducing the potential for movements in response to developmental, foraging, and seasonal habitat requirements (MBTSG 1998, Rieman and McIntyre 1993); and (5) reducing reproductive capability by eliminating the larger, more fecund migratory form from many subpopulations (MBTSG 1998, Rieman and McIntyre 1993). Therefore, restoring connectivity and restoring the frequency of occurrence of the migratory form will be an important factor in the recovery of bull trout.

Unfortunately, migratory bull trout have been restricted or eliminated in parts of their range due to stream habitat alterations including seasonal or permanent obstructions, detrimental changes in water quality, increased temperatures, and the alteration of natural stream flow patterns. Dam and reservoir construction and operations have altered major portions of bull trout habitat throughout the Columbia River basin. Dams without fish passage create barriers to fluvial and adfluvial bull trout which isolates populations. The operations of dams and reservoirs alter the natural hydrograph, thereby affecting forage, water temperature, and water quality (USDI 1997).

The FWS analyzed data on bull trout relative to subpopulations because fragmentation and barriers have isolated bull trout throughout their current range. A subpopulation is considered to be a reproductively isolated group of bull trout that spawns within a particular area of a river system. Subpopulations were considered at risk of extirpation from naturally occurring events if they were: 1) unlikely to be reestablished by individuals from another subpopulation, 2) limited to a single spawning area, and, either 3) characterized by low individual or spawner numbers, or 4) primarily of a single life-history form. The FWS rated a subpopulation as either "strong," "depressed," or "unknown," modified after Rieman *et al.* (1997). A subpopulation is considered "strong" if 5,000 individuals or 500 spawners likely occur in the subpopulation, abundance appears stable or increasing, and life-history forms were likely to persist; and "depressed" if less than 5,000 individuals or 500 spawners likely occur in the subpopulation, abundance appears to be declining, or a life-history form historically present has been lost. If there was insufficient abundance, trend, and life-history information to classify the status of a subpopulation as either "strong" or "depressed", the status was considered "unknown."

Subpopulations in the Columbia River DPS

The FWS recognizes 141 subpopulations of bull trout in the Columbia River DPS within Idaho, Montana, Oregon, and Washington, with additional subpopulations in British Columbia. Approximately 79 percent of these subpopulations are unlikely to be reestablished if extirpated and 50 percent are at risk of extirpation from naturally occurring events due to their depressed status (USDI 1998a). Many of the remaining bull trout occur as isolated subpopulations in headwater tributaries, or in tributaries where the migratory corridors have been lost or restricted. Few bull trout subpopulations are considered "strong" in terms of relative abundance and subpopulation stability. Those few remaining strongholds are generally associated with large areas of contiguous habitats such as portions of the Snake River basin in central Idaho, the upper Flathead Rivers in Montana, and the Blue Mountains in Washington and Oregon. The listing rule characterizes the Columbia River DPS as generally consisting of isolated subpopulations, without a migratory life form to maintain the biological cohesiveness of the subpopulations, and with declining abundance trends or status unknown.
Extensive habitat loss and fragmentation of subpopulations have been documented for bull trout in the Columbia River basin and elsewhere within its range (Rieman and McIntyre 1993). Reductions in the amount of riparian vegetation and road construction in the Columbia River basin due to timber harvest, grazing, and agricultural practices have contributed to habitat degradation through elevated stream temperatures, increased sedimentation, and channel

embeddedness. Mining activities have compromised habitat conditions by discharging waste materials into streams and diverting and altering stream channels. Residential development has threatened water quality by introducing domestic sewage and altering riparian conditions. Dams of all sizes, i.e., mainstem hydropower and tributary irrigation diversions, have severely limited migration of bull trout in the Columbia River basin. Competition from non-native trout (USDI 1998a) is also considered a threat to bull trout.

Generally, where status is known and population data exist, bull trout populations in the Columbia River DPS are declining (Thomas 1992, Pratt and Huston 1993, Schill 1992). Bull trout in the Columbia River basin occupy about 45 percent of their estimated historic range (Quigley and Arbelbide 1997). Quigley and Arbelbide (1997) considered bull trout populations strong in only 13 percent of the occupied range in the interior Columbia River basin. Rieman *et al.* (1997) estimated that populations were strong in 6 to 24 percent of the subwatersheds in the entire Columbia River basin.

Changes in status of the Lower Columbia River Recovery Unit

The overall status of the Lower Columbia River Recovery Unit of the Columbia River DPS has not improved since its listing on November 1, 1999. The status of the Lower Columbia River Recovery Unit in the Columbia River DPS has been affected by a number of actions addressed through Biological Opinions prepared under section 7 of the Act, and by several sections 10(a)(1)(B) permits issued for HCPs. Most of these actions resulted in a degradation of the environmental baseline; all permitted the incidental take of bull trout.

A number of HCPs have been completed within the range of the spotted owl in California, Oregon and Washington. Of these, one HCP was amended to include bull trout in the Columbia Basin DPS: the WDNR.

The WDNR's HCP amendment (USDI 1998b) to include bull trout allowed for incidental take of bull trout associated with habitat degradation/loss due to 29 miles of road construction and maintenance per year, and 158 acres of selective and thinning harvest per year. This amendment added only the Coastal-Puget Sound DPS and the lower Columbia River downstream from Greenleaf and Hamilton Creeks in the Columbia River DPS.

Relationship of the Subpopulations to Survival and Recovery of Bull Trout in a DPS

Leary and Allendorf (1997) reported evidence of genetic divergence among bull trout subpopulations, indicating relatively little genetic exchange between them. Recolonization of habitat where isolated bull trout subpopulations have been lost is either unlikely to occur (Rieman and McIntyre 1993) or will only occur over extremely lengthy time periods. Remnant or regional populations without the connectivity to rebound or support local populations have a greater likelihood of extinction (Rieman and McIntyre 1993, Rieman *et al.* 1997, MBTSG 1998).

Healy and Prince (1995) reported that, because phenotypic diversity is a consequence of the genotype interacting with the habitat, the conservation of phenotypic diversity is achieved through conservation of the subpopulation within its habitat. They further note that adaptive variation among salmonids has been observed to occur under relatively short time frames (e.g., changes in genetic composition of salmonids raised in hatcheries, and the rapid emergence of divergent phenotypes for salmonids introduced to new environments). Healy and Prince (1995) conclude that while the loss of a few subpopulations within an ecosystem might have only a small effect on overall genetic diversity, the effect on phenotypic diversity and, potentially, overall population viability could be substantial. This concept of preserving variation in phenotypic traits that is determined by both genetic and environmental i.e., local habitat factors, has also been identified by Hard (1995) as an important component in maintaining intraspecific adaptability i.e., phenotypic plasticity, and ecological diversity within a genotype. Hard argues that adaptive processes are not entirely encompassed by the interpretation of molecular genetic data; in other words, phenotypic and genetic variation in adaptive traits may exist without detectable variation at the molecular genetic level, particularly for neutral genetic markers. Therefore, the effective conservation of genetic diversity necessarily involves consideration of the conservation of biological units smaller than taxonomic species (or DPS). Reflecting this theme, the maintenance of local subpopulations has been specifically emphasized as a mechanism for the conservation of bull trout (Rieman and McIntyre 1993).

Based on this information, the FWS concludes that each bull trout subpopulation is an important phenotypic, genetic, and distributional component of its respective DPS. Therefore, adverse effects that compromise the functional integrity of a bull trout subpopulation will be considered an appreciable reduction in the likelihood of survival and recovery of the entire DPS, by reducing the distribution and potential ecological and genetic diversity of the DPS.

Conservation Needs of the Lower Columbia River Recovery Unit of the Columbia River DPS

The recovery of bull trout in the Lower Columbia River Recovery Unit of the Columbia River DPS will depend on the reduction of the adverse effects that result from dams, timber harvest, agriculture practices, road building, urbanization, fisheries management, and by remedying legacy effects from past activities. General conservation needs include the following:

- providing/maintaining stream passage and removing "man-made" impassable barriers to allow for recolonization of previously occupied habitat and for the promotion of genetic exchange;
- screening water control structures and diversions in order to prevent entrapment and injury;
- implementing land use (i.e. agricultural, forestry, industrial) practices that will minimize chemical and nutrient contaminated run-off and loss of riparian vegetation in order to improve water quality and quantity in streams;
- improving approaches to urbanization and road building, such as requiring setbacks from stream banks and marine shorelines, and adequately treating storm water run-off in order to minimize impacts to foraging and migratory habitats;

- reducing associated incidental mortality of bull trout from commercial, recreational, and tribal salmon and steelhead harvest; and
- restoring suitable habitat for all life history forms of bull trout in areas degraded by past human activities.

COASTAL CUTTHROAT TROUT

A status review of coastal cutthroat trout from Washington, Oregon, and California was conducted by NOAA Fisheries (Johnson *et al.* 1999). The status review determined there were six Evolutionarily Significant Units of coastal cutthroat trout along the coast of Washington, Oregon, and California. On April 5, 1999, the Services jointly proposed to list the coastal cutthroat population as threatened in southwestern Washington and the Columbia River, excluding the Willamette River above Willamette Falls (65 FR 16397). The proposal for listing was based upon widespread declines in abundance and the small population sizes of anadromous cutthroat trout throughout the lower Columbia River, and modifications to riverine and estuarine habitats. In April of 2000, the one-year deadline was extended by six months to obtain and review new information needed to resolve substantial scientific concerns about the status of the population (65 FR 20123). In 2000, the FWS assumed sole jurisdiction over all extant subspecies of cutthroat trout. (65 FR 21376). On July 5, 2002, the FWS withdrew the proposed rule to list coastal cutthroat trout (67 FR 44934).

Description

Coastal cutthroat trout are a subspecies of cutthroat trout. Behnke (1997) has proposed 14 extant subspecies of *O. clarki*. Life history strategies of coastal cutthroat trout are extremely diversified, perhaps more so than any other Pacific salmonid (64 FR 16397). The appearance of coastal cutthroat differs from other cutthroat trout subspecies by the numerous small to medium irregular-shaped spots covering virtually the entire sides of the body, often extending to the ventral surface and anal fin (Behnke 1992).

Habitat/Life History

Coastal cutthroat trout occupy a wide range of habitat types and display a diverse range of life history strategies, perhaps making them one of the more locally adapted species of the salmonid family. Their life history is complex with considerable variation within and between populations. Various life history forms frequently occur in the same streams (Johnson *et al.* 1999). There is also evidence that life history patterns can change within individual fish over time (Johnson *et al.* 1999). For practical reasons, Johnson (1999) and others, have identified three general life history forms for coastal cutthroat trout: nonmigratory, freshwater migratory, and saltwater migratory. Within the southwestern Washington/Columbia River DPS, all three migratory forms have been identified.

Non-migratory coastal cutthroat trout typically inhabit small streams, often in headwater areas. Fish typically live their entire life within a very small reach of stream. These fish normally do not grow to more than 150mm to 200mm and seldom live more than three years (Trotter 1989).

Freshwater-migratory coastal cutthroat trout perform migrations within freshwater only. Several migration strategies have been observed: populations that migrate from large streams to smaller ones to spawn (fluvial-adfluvial); fish that reside in lakes the majority of the time but migrate upstream to spawn (lacustrine-adfluvial); and fish that live in lakes the majority of the time but migrate downstream to spawn in the lake outlet (lacustrine) (Johnson *et al.* 1999).

Saltwater-migratory coastal cutthroat trout migrate from freshwater natal areas to marine waters. Fish smolt in the spring at age 2 and migrate to protected near shore waters. At age 3 or 4 they migrate to the open ocean (Trotter 1989). The fish then return in the fall or winter to feed, seek refuge, or spawn (Johnson *et al.* 1999).

The spawning period for anadromous cutthroat trout ranges from December to June (Trotter 1989). Coastal cutthroat trout spawn in low gradient reaches of small tributaries, or in the lower regions of streams (Trotter 1997). This appears to be an adaptation to isolate their nursery/rearing ground from other, more competitive, species such as steelhead (Stolz and Schnell 1991). The preferred spawning substrate is pea to walnut sized gravel, in 6-18 inches of water, with pools nearby for escape cover. Actual spawning may extend over a period of 2 to 3 days (Trotter 1997). Cutthroat eggs require approximately 300 temperature units for incubation, and an additional 150 to 200 units for emergence to occur (Stolz and Schnell 1991).

Emergence of juvenile cutthroat occurs from March to mid-July, depending on spawning date and water temperature (Trotter 1997). Newly-emerged cutthroat trout are very small (<1.0 inch total length (TL)). Juvenile cutthroat move immediately to low-velocity, lateral habitats where they rear for two or more years, seeking pools and other slow water habitats with root wads and large wood for cover (Trotter 1997). Often, coho fry are present in the same habitat, and the larger coho will drive the cutthroat into riffles, where they will remain until fall and winter (Sabo 1995). Seaward migration of cutthroat smolts peaks in mid-May at 2, 3, or 4 years of age (Trotter 1997). Average length at this time was found to be 6 inches TL (Johnston 1979). During the marine phase of their life cycle, juvenile and adult coastal cutthroat trout appear to utilize waters near the shore, usually in areas relatively near their natal streams (Moyle 1976; Johnston 1982; Trotter 1997). Both gravel beaches with upland vegetation, and nearshore areas containing large logs and other LWD, are used during the marine residency phase.

Like steelhead, adult coastal cutthroat trout are repeat spawners, but unlike steelhead, coastal cutthroat trout recover quickly to pre-spawn condition (Trotter 1997). They may live to an age of 7 or 8 years, spawning three, four, or even as many as five times during their life (Trotter 1997). Coastal cutthroat trout generally remain inshore or in areas of reduced salinity while in salt water and will rarely, if ever, overwinter in saltwater; some of the returning fish may not spawn during their first or second migrations back into freshwater (Behnke 1997; Trotter 1997). Spawning fish home precisely to specific tributaries while non-maturing fish do not always return to their home stream to feed or when seeking an over winter habitat (Johnston 1982). Coastal cutthroat trout are usually smaller than other anadromous salmonids, and rarely exceed 20 inches TL. This size appears to be adaptive for entering small tributaries where interspecific competition for habitat with other, larger, salmonids is reduced (Pearcy 1997).

Older and larger individuals in any cutthroat trout population require deeper pools within streams. Well-developed pools allow cutthroat trout to survive occasional extreme flow years or cycles of extreme drought. Fine gravels are necessary for resident cutthroat spawning and redd construction.

Distribution

Sea-run cutthroat trout numbers have declined precipitously in some portions of their range in recent years. They are widely distributed throughout the fresh and near shore marine waters of the Pacific Northwest. The distribution of coastal cutthroat trout is broader than any other cutthroat trout subspecies (Johnson 1999 *et al.*). It extends from the Eel River in northern California to the Kenai Peninsula in Alaska, and eastward from the ocean normally less than 60 miles and very rarely up to 100 miles (Johnson *et al.* 1999). In Washington, the Cascades appear to limit its eastward distribution. The southwestern Washington/Columbia River Evolutionary Significant Unit of coastal cutthroat trout has been declining, and continues to decline throughout the lower Columbia River. Other cutthroat populations appear stable at this time.

PACIFIC LAMPREY

Status

Pacific lamprey (*Lampetra tridentata*) is listed as a federal species of concern in Washington. Pacific lamprey has no designated state listing status in Washington. In Oregon, this species is considered a species of concern, due primarily to its apparent widespread decline. Although the reasons for this decline are poorly understood, it is likely due to conditions both in oceanic and freshwater habitats; passage past hydroelectric and irrigation dams may also be a contributing factor throughout its range (ODFW 1996, Renaud 1997). Notably, a related species, the Arctic lamprey (*Lampetra japonica*), faces significant mortality in late spring and summer when low stream levels leave burrowed ammocoetes (larvae) stranded in dry stream edges (Scott and Crossman 1973).

A recent study by the Oregon Department of Fish and Wildlife (2002) attributes the decline in lampreys to several habitat-related factors. Although lamprey has a remarkable ability to use their sucker mouths to climb natural barriers and penetrate headwater areas unavailable to other fish, man-made barriers represent a migration barrier. The lamprey's ability to climb is negated by the smooth surfaces of manmade barriers. Fish ladders pose problems, as well, for lamprey because they are weak swimmers and lack the ability to jump. Culverts also pose similar problems for migrating lamprey. Smooth surfaces, high velocities, and perched entrances pose severe passage barriers. A presence/absence study in coastal Oregon demonstrated that lamprey was not found above many road culverts. Tide gates, hatchery weirs, and other small barriers and diversions were also determined to be barriers to lamprey migration. Downstream passage around dams and diversions may present a greater hazard for lampreys. Lamprey ammocoetes or recently metamorphosed lampreys are of small diameter and not strong swimmers, so their movements are at the mercy of flow velocities. Lampreys may pass under fish screens, go through them, or become easily impinged upon them. Oregon Department of Fish and Wildlife also cites pollution, chemical spills, and other water quality problems as well as dredging, altered hydrographs, scouring, rapid water draw-downs, and floodplain development as other factors that pose concerns to lamprey populations.

Species Description

Pacific lamprey is a member of the Petromyzonidae family which is ancestral to most vertebrates and all fish. Adult Pacific lamprey can be identified by the three large supraoral lamina teeth cusps in the suckerlike mouth. Females have a well-developed ventral fin fold, but the males have none. Larvae or ammocoetes have a dark line of pigment above and below the tip of the tail (Wydoski and Whitney 1979). Filter-feeding ammocoetes reside in natal streams for several years and may benefit from increased nutrient input from salmonid carcasses.

Life History

Pacific lamprey exhibit an anadromous life history, although landlocked populations have been reported from California, Oregon, Idaho and British Columbia (ODFW 1996; Wallace and Ball 1978; Wydoski and Whitney 1979). Adults are parasitic on a wide variety of fish, including benthic groundfish species as well as pelagic species such as Pacific herring (*Clupea harengus*) and Pacific salmon (*Oncorhynchus spp.*) (Beamish 1980; Scott and Crossman 1973; Stewart 1981). Pacific lamprey appear not to be piscvorous during metamorphosis or the spawning migration (Richards and Beamish 1981; Whyte *et al.* 1993). Pacific lamprey generally attach to their prey ventrally, especially near the pectoral fins; while river lamprey commonly attach dorsally (Cochran 1986). Adult Pacific lamprey are at times a very important food source for both saltwater and freshwater predators. In the Rogue River estuary in Oregon, Roffe and Mate (1984) documented that California sea lion (*Zalophus californianus*); Steller (or Northern) sea lion (*Eumetopias jubatus*); and the Pacific harbor seal (*Phoca vitulina richardsi*) fed heavily upon Pacific lampreys. Beamish (1980) cited observations of Pacific lamprey in the stomachs of sperm whales (*Physeter catodon*). Blue heron (*Ardea herodias*) and mink (*Mustela vison*) have been observed eating Pacific lamprey in fresh-water environments (Beamish 1980).

After spending approximately 3.5 years in salt water, adults enter natal streams between July and October, and gradually move upstream to spawn the following spring (Beamish 1980; Hart 1973). Migrating adults have been known to pass vertical barriers such as dams by slowly ascending smooth walls by the use of their sucker-like mouth (Wydoski and Whitney 1979). The length of sexually mature adults in Canada has ranged from 16-72 cm, but adults will atrophy approximately 20 percent of their maximum length prior to spawning (Beamish 1980). The spawning nest or redd usually consists of a shallow depression built in sand and gravel substrates at the upstream edge of a low gradient riffle (Close *et al.* 1995; Hart 1973; Scott and Crossman 1973). Flow and depth seems to be important in redd site selection, where velocities range from 1.6 to 3.3 ft/sec (0.5 to 1.0 m/sec) and depths of 1.3 to 3.3 ft (0.4 to 1.0 m) have been observed (Close *et al.* 1995). Lake spawning has been observed, but is uncommon (Russell *et al.* 1987). Adults generally die soon after spawning, although Michael (1980 and 1984) has observed some occurrence of repeat spawning returns of marked adults in traps within Puget Sound, Washington. After fertilization, eggs hatch in 2 - 4 weeks (19 days at 59°F (15°C) and newly hatched larvae (ammocoetes) remain in their nests for 2 - 3 weeks before drifting downstream and burying themselves in mud at the bottom of pools, or other areas of soft mud and sand (Hart 1973; Moyle 1976).

Ammocoetes are filter-feeders that subsist on algae or other organic matter for up to 5-6 years in their freshwater habitat (Moyle 1976; Wydoski and Whitney 1979). Under experimental conditions, emergent larvae 0.3 to 0.4 inches (7 to 10 mm) in length preferred mud over sand and gravel substrates (Close *et al.* 1995). Current velocities greater than 1.0 ft/sec (0.31 m/sec) prohibited burrowing by emergent larvae in all substrates, but larger larvae 1.6 to 2.0 inch (40 to 50 mm) are capable of burrowing in sand. In Oregon, the current over ammocoetes beds ranged from 0.3 to 1.6 ft/sec (0.1 to 0.5 m/sec) (Close *et al.* 1995). Metamorphosis begins in July and the known period of entry into salt water is from December to June, parasitic life starts soon after salt water entry (Beamish 1980; Whyte *et al.* 1993). Increased water flows during runoff can encourage out-migration, by washing away sand and silt the larvae require for anchoring themselves to the bottom (Hardisty and Potter 1971).

Distribution

The Pacific lamprey is distributed from Hokkaido, Japan, through the Bering Sea and Aleutian Islands to Baja California, and Mexico (Ruiz-Campos and Gonzalez-Guzman 1996; Wydoski and Whitney 1979). Scott and Crossman (1973) describe this species as penetrating all major rivers, often to headwaters. The limited amount of ecological information currently available about Pacific lamprey is insufficient to evaluate the species' population status in Washington state. However, it is a native fish of the Lewis River system and has cultural, utilitarian, and ecological significance (Close *et al.* 1995).

RIVER LAMPREY

Status

The river lamprey (*Lampetra ayresi*) is a federal and state species of concern in Washington state. Little is known regarding the status of river lamprey populations in Washington. Population declines of the related Pacific lamprey (*Lampetra tridentatatus*) are primarily due to conditions both in oceanic and freshwater habitats; passage past hydroelectric and irrigation dams (ODFW 1996; Renaud 1997). Results of trawl surveys and surveys of sockeye smolts at the Ballard Locks indicate that river lamprey is a relatively common species in Lake Washington. Within the Straits of Georgia in British Columbia, approximately 667,000 adult lampreys were thought to exist in 1975 (Stewart 1981).

A recent study by the Oregon Department of Fish and Wildlife (2002) attributes the decline in lampreys to several habitat-related factors. Although lamprey has a remarkable ability to use their sucker mouths to climb natural barriers and penetrate headwater areas unavailable to other fish, man-made barriers represent a migration barrier. The lamprey's ability to climb is negated by the smooth surfaces of manmade barriers. Fish ladders pose problems, as well, for lamprey because they are weak swimmers and lack the ability to jump. Culverts also pose similar problems for migrating lamprey. Smooth surfaces, high velocities, and perched entrances pose severe passage barriers. A presence/absence study in coastal Oregon demonstrated that lamprey was not found above many road culverts. Tide gates, hatchery weirs, and other small barriers and diversions were also determined to be barriers to lamprey migration. Downstream passage around dams and diversions may present a greater hazard for lampreys. Lamprey ammocoetes or recently metamorphosed lampreys are of small diameter and not strong swimmers, so their movements are at the mercy of flow velocities. Lampreys may pass under fish screens, go through them, or become easily impinged upon them. Oregon Department of Fish and Wildlife also cites pollution, chemical spills, and other water quality problems as well as dredging, altered hydrographs, scouring, rapid water draw-downs, and floodplain development as other factors that pose concerns to lamprey populations.

Species Description

River lamprey is a member of the Petromyzonidae family which is ancestral to most vertebrates and all fish. Adult river lamprey can be identified by the two large supraoral lamina teeth cusps in the suckerlike mouth. Larval river lamprey has a black blotch in the membrane at the tip of the caudal fin (Wydoski and Whitney 1979). Filter-feeding ammocoetes reside in natal streams for several years and may benefit from increased nutrient input from salmonid carcasses.

Life History

Biological information is not as well defined for river lamprey as it is for the larger-sized Pacific lamprey. Salt water mature adults are parasitic almost exclusively on pelagic species such as Pacific herring (*Clupea harengus*) and Pacific salmon (*Oncorhynchus spp.*) (Beamish 1980, Beamish and Neville 1995, Scott and Crossman 1973). In most British Columbia streams, river lamprey become parasitic before reaching the ocean (Stewart 1981). In Lake Washington, sockeye (*O. nerka*) salmon smolts are thought to be the preferred prey for recently metamorphosed river lamprey. In 1991, Beamish and Neville (1995) concluded that river lamprey in the Fraser River plume killed approximately 65 percent and 25 percent of the total Canadian hatchery and wild production of coho and chinook salmon, respectively. This predation is considered to be significant upon commercially important fish stocks in British Columbia (Stewart 1981). River lamprey generally attach to their prey dorsally, while Pacific lamprey tend to attach ventrally, near the pectoral fins (Cochran 1986). Unlike numerous reports on Pacific lamprey, the extent of other animals feeding on river lampreys is unknown.

Between September and late winter, river lamprey return to freshwater after spending approximately two years in salt water (Beamish 1980). Spawning occurs during winter to spring in clean gravel areas of small tributaries (Beamish 1980, Moyle *et al.* 1995). The mean length of mature marine adults in Canada was 9.8 inches (25 cm) in September, but adults atrophy approximately 20 percent of their maximum length prior to spawning (Beamish 1980). River lamprey larvae (ammocoetes) may remain in their natal streams for several years, usually in silt-sand backwaters and eddies near the bank (Hart 1973). The ammocoetes are toothless, and they feed on microscopic plants and animals (Scott and Crossman 1973; Hart 1973). Metamorphosis occurs in late July with downstream migration occurring the following year from May to July (Beamish 1980; Beamish and Youson 1987). In the final stages of metamorphosis, lampreys congregate just upstream from salt water, entering the ocean in late spring (Moyle *et al.* 1995).

From June until September they increase in size by an estimated 4.3 to 5.5 inches (11-14 cm) and 0.4 to 0.6 ounces (12-18 g).

Distribution

River lamprey has been collected from coastal streams and rivers from San Francisco Bay north to Juneau, Alaska (Wydoski and Whitney 1979). Scott and Crossman (1973) reported that this species has been found in fresh and salt water across the same range. According to Wydoski and Whitney (1979), no detailed distribution records are available for Washington, but the species probably occurs in most major rivers. The regional distribution or river lamprey is relatively unknown because species identification of juvenile fish is rarely performed during river and stream surveys.

OREGON SPOTTED FROG

Status

The Oregon spotted frog (*Rana pretiosa*) is a federal candidate species. The Oregon spotted frog is listed as a state endangered species in Washington. The species is considered a sensitive species by the FWS. This species was considered conspecific with the Columbia spotted frog (*R. luteiventris*) until very recently, when spotted frog populations in the Columbia River basin were reclassified as Columbia spotted frogs (Green *et al.* 1997). Limited distribution and isolation of Oregon spotted frog populations have prompted concern for this species' survival (WDFW 1994a). Loss of wetland habitat (e.g., development, dams) and/or alteration of the character of wetlands (e.g., hydrological modifications, introduction of exotic plants such as reed canarygrass, grazing in some circumstances) have been the main reasons for decline of this species (McAllister and Leonard 1997). Other threats to this species include introduction of bullfrogs and predatory fishes and susceptibility to toxic chemicals (WDFW 1994a; Hayes and Jennings 1986).

Species Description

As adults, Oregon spotted frogs reportedly range from about 1.75-4 in (44–100 mm) in body length. Males in southwest British Columbia reach a maximum of 64 mm snout-vent length. Females in the same population reach 78 mm in snout-vent length. In Thurston County, adult males average 56 mm snout-vent length [range from 46–65 mm (N=56)] and adult females average 66 mm snout-vent length [range from 51–76 mm (N=66)]. Using pooled samples of frogs from the two populations in the south Cascades of Washington, adult males average 57 mm [range from 46-66 mm (N=13] and adult females average 75 mm [range from 59-89 mm (N=14)]. The size disparity between males and females is typical. Females exceeding 90 mm snout-vent length are rare but a few exist in museum collections. Black spots with light centers are typically present on the head and back. The spots become larger and darker with age and take on an increasingly ragged-edged appear. Coloration varies with age. Juveniles are usually some shade of brown, occasionally olive green. Adults can be brown or reddish brown; tending to become increasingly red with age. Large, presumably older, frogs are often brick red over most of the dorsal surfaces. The dorsal lateral folds usually are lighter in color, ranging from tan to orange. These folds extend posteriorly from behind the eyes but begin to break up or discontinue altogether midway along the dorsum. Ventrally, juveniles are white or cream in color with reddish pigments on the underlegs and abdomen developing with age. Adults show a vivid orange-red on the underlegs and red surface pigments on the abdomen increase with age. Older animals are frequently red on the entire abdomen forward to the chest. A brown, gray, or tan mottling covers an otherwise white throat and underbelly (McAllister and Leonard 1997).

Life History

Oregon spotted frogs begin to breed by 3 years of age; males may breed at 1 year, but generally at age 2, and females breed by 3 years of age (McAllister and Leonard 1997). Male Oregon spotted frogs are not territorial and may gather in large groups of 25 or more individuals at specific locations (Leonard *et al.* 1993). Breeding occurs in February or March at lower elevations and in late May or early June at higher elevations, and may also vary with latitude i.e., southern populations may breed earlier than more northern populations (Leonard *et al.* 1993). Males and females probably separate soon after egg laying with females returning to fairly solitary lives. Males may stay at the breeding site, possibly for several weeks, until oviposition (egg laying) is completed (McAllister and Leonard 1997). Oregon spotted frogs breed in shallow pools (5–30 cm (2–12 in.) deep) that are near flowing water, or which may be connected to larger bodies of water during seasonally high water or at flood stage. Characteristic vegetation includes grasses, sedges, and rushes, although eggs are laid where the vegetation is low or sparse (McAllister and Leonard 1997).

At Conboy Lake National Wildlife Refuge, typical egg-laying sites include shallow, gradually receding shorelines on benches of seasonal lakes, marshes, bogs, ponds, floating vegetation mats, and wet meadows. All of these sites dry up later in the season (J. Engler, in litt. 1999). Some eggs, however, are deposited along the edges or shallow benches of permanent, human-altered wetlands or irrigation canals and ditches. Although native vegetation is the preferred substrate for egg-laying, Oregon spotted frogs will also use non-native reed canarygrass (*Phalaris arundinacea*) that is mixed with native vegetation and grazed or mowed (J. Engler, in litt. 1999). Because a low pH or an elevated pH can have negative affects on amphibians, the pH of the water should probably be nearly neutral, although specific range tolerances of the Oregon spotted frog are not known (Boyer and Grue 1995).

Oregon spotted frogs' eggs are extremely vulnerable due to the species' egg-laying habits. Females may deposit their egg masses at the same locations in successive years, indicating the sites may have unique characteristics (Licht 1971). Use of traditional oviposition sites that may have limited availability because of unique characteristics, and the possibility that adults may have limited flexibility to switch sites, makes the Oregon spotted frog particularly vulnerable to oviposition site modification (Hayes 1994). Egg masses are laid communally in groups of a few to several hundred (Licht 1971; Nussbaum *et al.* 1983; Cook 1984; Hayes 1997; Engler and Friesz 1998). Eggs are laid in shallow, often temporary, pools of water, which can result in high mortality rates for eggs due to desiccation and/or freezing (Leonard *et al.* 1993). Oregon spotted frogs experience high mortality rates at all stages of the life cycle (Licht 1974).

Oregon spotted frogs remain in warm water marshes except during the overwintering period. Recent data indicate that overwintering sites are associated with springs or other locations with low-flow conditions. This choice of overwintering site may reflect selection of microhabitats that do not freeze and have high oxygen levels (Pearl 1999; Pearl and Bury 2000). Oregon spotted frogs apparently burrow in mud, silty substrate, or clumps of emergent vegetation when inactive during periods of prolonged or severe cold (Hayes 1994; McAllister and Leonard 1997). This species is generally inactive during the winter, except on warmer days.

Oregon spotted frogs has a number of documented and potential natural predators, including a variety of snake, bird, and mammal species (McAllister and Leonard 1997). Tadpoles may be preyed upon by numerous vertebrate predators including birds, snakes, newts, salamanders, and fish as well as some invertebrate species, such as beetles and leeches. Predation and competition with a number of non-native fish and bullfrogs, which have been introduced into the historic range of the Oregon spotted frog, have undoubtedly contributed to the decline of this species (Hayes and Jennings 1986; Hayes 1994; McAllister and Leonard 1997).

Habitat

The Oregon spotted frog inhabits emergent wetland habitats in forested landscapes, although it is not typically found under forest canopy. Oregon spotted frogs, however, have been found in riparian forests and areas with dense shrub cover (McAllister and Leonard 1997). This species is not an old-growth forest obligate, but forested areas may represent important refugia from further population losses (Blaustein *et al.* 1995). Historically, this species was also associated with lakes in the prairie landscape of the Puget Sound lowlands (McAllister and Leonard 1997). Warm water marsh habitats for the Oregon spotted frog have been found at elevations from sea level to1700 meters (m) (5500 feet (ft)) in a north-south gradient—approximately 300 m (1000 ft) in British Columbia, 1000 m (3000 ft) in Washington, 1200 m (3500 ft) in northern Oregon, and 1700 m (5500 ft) in southern Oregon (Dunlap 1955; McAllister and Leonard 1997; Hayes 1997, 1998).

This is the most aquatic native frog species in the Pacific Northwest and is almost always found in or near a perennial body of water (e.g., spring, pond, lake, sluggish stream). There is probably a relationship with fairly large marshes (approximate minimum size of 9 acres) that can reach suitably warm temperatures and can support a large enough population to persist despite high predation rates (Hayes 1994). Oregon spotted frog habitat includes zones of shallow water and abundant emergent or floating aquatic plants, which are used for basking and escape cover from predators (Leonard *et al.* 1993; Corkran and Thoms 1996; McAllister and Leonard 1997). Recent research indicates that Oregon spotted frogs have different microhabitat preferences or requirements in the breeding season, the active (summer) season, and for overwintering (Pearl 1999).

Preliminary results of a habitat utilization study at Dempsey Creek in Washington, indicate that adult frogs move to remnant pools in response to reduced water levels from spring to summer. Adults disperse from these pools during increased precipitation in September and October. Oregon spotted frogs stayed within the study area throughout the year. Individuals equipped with radio transmitters stayed within 800 m (2600 ft) of capture locations (Watson *et al.* 1998).

Recaptures of individuals in the Buck Lake, Oregon, population indicated that adult frogs often move less than 100 m (300 ft) between years (Hayes 1998c). Movement data for the Penn Lake, Oregon, population was consistent with other studies suggesting that most adults make relatively small movements during the peak of the active season, but can cover distances upwards of 100 m (300 ft). Movements over the longer distances occurred near the end of the summer active season when adults might be expected to move toward overwintering habitats (Pearl and Bury 2000).

Oregon spotted frogs at Dempsey Creek selected areas of relatively shallow water (10–30 cm (4–12 in.) deep), with less emergent vegetation, but more submergent vegetation than adjacent habitats. They avoided dry, upland areas of pasture grass (Watson *et al.* 1998). Cook (1984), however, stated that spotted frogs will forage for insects and other invertebrates in adjacent woods and meadows. At Conboy Lake National Wildlife Refuge, modified creeks, irrigation canals, and ditches are used extensively for overwintering and summer habitat (J. Engler, in litt. 1999). In Oregon, Pearl (1999) found that adult Oregon spotted frogs used a wider range of wetland types and may use smaller habitats (less than 1 ha (2.5 ac)) in the nonbreeding season.

Distribution

Historically, the range of the Oregon spotted frog in Washington state was distributed through the lowlands of the Puget Trough from the Canadian border south to Vancouver, Washington, and east into the southern Washington Cascades (McAllister *et al.* 1993; McAllister 1995; McAllister and Leonard 1997). It has been estimated that this species has been lost from over 90 percent of its original range (Hayes 1997). Currently, only four populations are known to occur in Washington: two in the south Puget Sound lowlands (Dempsey Creek and Beaver Creek) and two in the south-central Cascade Mountains (Trout Lake and Conboy Lake) (McAllister and Leonard 1997). In Washington, the Oregon spotted frog has been documented historically in eleven localities in Clark, King, Klickitat, Pierce, Skagit, Snohomish, and Thurston Counties (Hayes 1997; McAllister and Leonard 1997). Populations are currently known to occur only in Klickitat, Skamania, and Thurston Counties (Leonard 1997; McAllister and Leonard 1997).

ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR §402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed federal projects in the action area that have undergone section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress. Such actions include, but are not limited to, previous mining activities in the East Fork Lewis River, river channel alterations, flood control structures, road construction, timber harvest, deforestation from agriculture, urban encroachment, and other land-use activities. The following discussion of the Environmental Baseline applies to all covered species.

Habitat conditions in the East Fork Lewis River have been significantly affected by past forest harvest activities as well as large-scale natural events in the watershed. Repeated large-scale stand-replacement fires burned large portions of eastern Clark County between 1902 and 1952.

The largest fire, the Yacolt Burn, occurred in 1902 and covered an estimated 238,900 acres of federal, state, and private forest lands. Other large fires repeatedly burned over portions of the same area, with some areas burning as much as five times. The last of these large-scale fires occurred in 1952 (WCC 2000).

Prior to Euro American settlement, the lower East Fork Lewis River in the vicinity of the Daybreak Mine site was a braided channel with extensive associated wetlands (USFWS and NOAA Fisheries 2003). By 1937, the development of farmland and the infrastructures necessary to support farming in the floodplain (levees, ditches, etc.) had confined the river to a single channel bordered by ephemeral floodplain sloughs (Collins 1997). From 1930 through the 1960, much of the wetlands and sloughs were drained, filled, and converted to agricultural lands. In the lower east Fork Lewis River (west of the Heisson USGS gage), agriculture is still the dominate land use. Approximately 43 percent of the area is categorized as commercial agriculture, with an additional 8 percent as hobby farms. Ten of the eleven commercial dairy farms in the entire watershed are in this lower reach (Hutton 1995b). Agricultural lands within the lower watershed pose a risk to overall water quality (Geo Engineers 2001). As an example, the McCormick Creek sub-basin, with 60 percent of its land in agricultural uses, consistently has had the poorest water quality in terms of fecal coliform, ammonia/ammonium, total nitrogen, soluble reactive phosphates, turbidity, and total phosphorus (Hutton 1995b).

Road densities also increased significantly from 1930 to 1960. In many places roads and bridges further confined the East Fork Lewis River and its associated floodplain. The Daybreak Bridge just upstream of the Daybreak Mine site is one example.

Although it is not precisely known when gravel mining began in the lower East Fork Lewis River, gravel mining began in about 1940 in most Washington rivers (Collins 1997). Several previously mined areas are located in the hydrological floodplain below Daybreak bridge including county pits 1 and 2, Mile 9 pit, the Ridgefield pits, and the Daybreak Mine ponds (USFWS and NOAA Fisheries 2003). Mining and processing at the Daybreak Mine site began in 1968 and the site has operated under a WDNR's Surface Mining Permit since 1971. Three previous owners mined gravel from all or part of what are now referred to in the final HCP as existing Ponds 1, 2, 4, and 5. Storedahl began gravel mining and processing at the site in 1987. Under their ownership, Pond 3 was excavated as well as a portion of Pond 1. All gravel extraction at the Daybreak Mine site concluded in 1995. Processing activities continued until 2001.

Historic gravel mining activities in the vicinity of the Daybreak Mine site have influenced the morphology of the river. In 1995, the East Fork Lewis River avulsed into an abandoned gravel pit (RM 9 Pit) located near RM 9. A large meander bend was abandoned during this event. During the February 1996 flood, the river avulsed into the southeast corner of Ridgefield Pit No. 7, flowing back into the main channel at the northwest-most point of Pit No. 7 (Miller 1996). This resulted in the abandonment of approximately 1500 feet of main channel. In November of 1996 during a subsequent flooding event, the river migrated into Ridgefield Pit No. 1, flowed through the other Ridgefield pits, and reentered the main channel at the previously described location in the northwest corner of Pit No. 7. This avulsion led to the relocation of 3200 feet of main channel (Norman *et al.* 1998). Past avulsions into abandoned gravel pits have altered the hydraulics and sediment transport characteristics of the East Fork Lewis River. Other abandoned or mined out gravel pits exist along the river in the vicinity of the Action Area and lie within the channel migration zone of the river. These pits, including the existing Daybreak Mine ponds, county Pits 1 and 2, and Ridgefield Pit 9, constitute the existing baseline condition and may influence river hydraulics and sediment transport characteristics in the future.

An avulsion is defined as a rapid and unexpected shift in channel position that causes a portion of the existing channel to be abandoned. An avulsion of the East Fork Lewis River into the locations described above could again alter the location of the main channel resulting in the abandonment of a section or sections of the main channel. The hydraulic and sediment transport characteristics of the river may also be affected upstream, within, and downstream of these locations. The extent of these changes and their associated impacts depends on the location of any future avulsion. Because of their unexpected nature, the timing of any future avulsion in the locations described above cannot be definitively predicted. But, based on estimates of sediment transport associated with current channel conditions in the vicinity of the proposed project, an avulsion is less likely to occur in the near-term (30 years) (West Consultants, Inc. 2001). Sediment transport estimates developed for the proposed project suggest that it could take approximately 25 to 30 year for the Ridgefield pits to fill with sediments. And, until the Ridgefield pits are substantially filled, lateral migration of the channel in the vicinity of the project is less likely to occur. Once the pits are filled, the East Fork Lewis River is more likely to exhibit normal channel migration patterns and an avulsion into the locations described previously is more likely to occur. An avulsion into the existing Daybreak Mine ponds, although more likely to occur once the Ridgefield Pits are filled with sediments, is also confounded by existing and future development such as roads. An avulsion into county Pits 1 and 2 or Ridgefield Pit 9 is a more likely scenario, in the near term.

BULL TROUT STATUS (Action Area)

No comprehensive surveys have been conducted for bull trout in the East Fork Lewis River. The Lewis River Core Area of the Lower Columbia Recovery Unit of the Draft Recovery Plan for Bull Trout includes the mainstem Lewis River and tributaries downstream to the confluence with the Columbia River, with the exclusion of the East Fork Lewis River (FWS 2002b). Foraging bull trout from either the Lewis River Core Area or the lower Columbia River may enter the East Fork Lewis River when conditions are suitable. The population of bull trout in the upper Lewis River is isolated from the mainstem Lewis River and, subsequently, the East Fork Lewis River, which joins the Lewis River approximately 3 miles upstream of the Columbia River. A series of three dams and their associated reservoirs created for hydroelectric power generation block upstream fish migration. Fish that pass through lower dam have access to the lower Lewis River and the East Fork Lewis River. It is not known how the present hydroelectric reservoirs have affected the Lewis River Core Area of bull trout given some uncertainty as to what bull trout life histories existed before construction of the hydro projects. Two theories are possible: 1) that the population of bull trout in the upper Lewis River was fluvial, with adults residing in the Columbia River and migrating into the Lewis River to spawn; and, 2) the population was fluvial and completed its life cycle entirely in the Lewis River and its tributaries. There is some archeological evidence indicating the possible existence of anadromous bull trout in the lower Columbia River and some of its tributaries. The WDFW (1998) believes that both anadromous and fluvial bull trout/Dolly Varden utilized the Lewis River downstream of Merwin Dam before the dams were constructed.

Whichever life history strategy theory is correct, the effect of conversion of the population to an adfluvial strategy is unknown. The reservoirs may be providing a greater prey base than the original riverine habitat albeit the prey species are not the same. However, upstream migration between the dams is precluded and habitat for spawning and rearing is limited. If the original population was a fluvial type that utilized upper Lewis River tributaries for spawning and rearing, the availability of habitat has not changed appreciably since that time. An exception may be Ole and Rain Creeks via the original Lewis River channel. Historically, Ole and Rain creeks may have provided some habitat for bull trout, but presently both creeks are intermittent at their mouths during the bull trout spawning migration season. Currently, Rain Creek is in an extremely aggraded condition. Whether this is a natural condition or is caused by logging and road building in the upper watershed is not clear.

As of 1997, only migratory (adfluvial) bull trout have been identified in these reservoirs (WDFW 1998a). No known spawning sites are accessible to bull trout in tributaries to Merwin Reservoir or the upper Lewis River. Therefore, bull trout found in Lake Merwin are probably due to spill and are not considered a subpopulation. Bull trout in Lake Merwin could pass through Merwin Dam and end up in the East Fork Lewis River via the Lewis River.

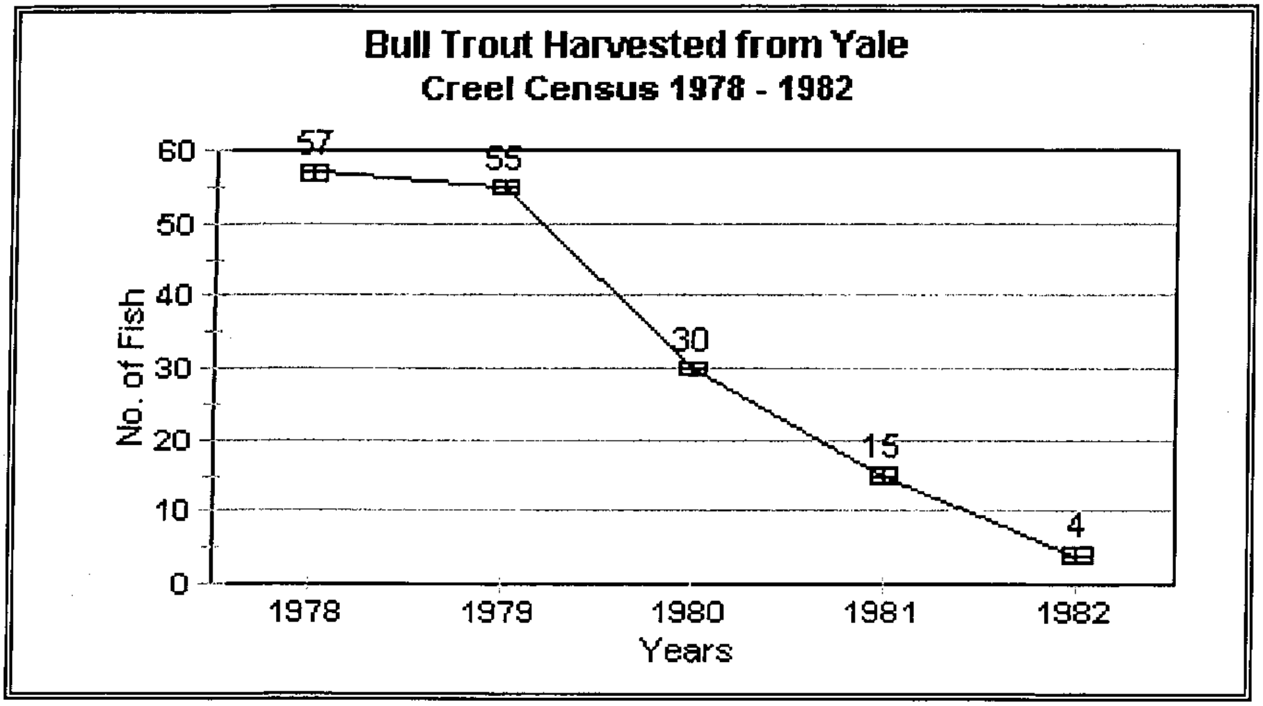
The Lewis River Core Area population was verified by recent genetic analysis (Spruell *et al.* 1998). This analysis indicated that upper Lewis River bull trout are similar to the Columbia DPS, but that Yale and Swift Reservoir bull trout differ significantly. They suggest that some genetic separation could have occurred between the two groups before construction of the dams, but that it is unlikely that the 35 years of separation created by the dams could have resulted in genetic drift to this extent. They also suggest that if population sizes are approaching extinction, transfer of individuals between reservoirs may be appropriate. The FWS does not believe the Lewis River Core Area population is at risk of extinction in the near term. But if conditions change or trends indicate a declining population, then this will need to be re-evaluated.

Merwin, Yale and Swift dams segregate the upper Lewis River and do not allow upstream passage. The occurrence of limited downstream passage by bull trout over these dams or through the turbines is assumed based on observed adult bull trout in Merwin Reservoir and subadults in the Swift No. 2 power canal. Bull trout currently occupy 22.1 km (11.9 mi) of the mainstem Lewis River including identified spawning tributaries in Pine, Rush, and Cougar creeks (USFS 1995). Although Platts *et al.* (1995) concluded that insufficient information existed to determine the status and trends of bull trout in Swift and Yale reservoirs, WDFW (1998) considers the subpopulations to be depressed due to "chronically low abundance." The status summary for the Klamath and Columbia DPS list both the Swift and Yale subpopulations as depressed (FWS 1998).

The primary limiting factor for Yale and Swift bull trout production seems to be the availability of adequate spawning and rearing habitat. The only known bull trout spawning of the Yale subpopulation occurs in Cougar Creek. The fact that only one and three-quarter miles of spawning and rearing habitat in Cougar Creek exists for the Yale population may explain the chronically low numbers of spawning adults observed each fall since records have been kept. With the exception of possible rearing habitat in Ole and Rain creeks, there are limited opportunities for expanding or improving habitat for the Yale bull trout population. Graves observed bull trout spawning in the Swift bypass reach in 1979, 1981, and 1982 (Graves 1979, Graves 1983). However, the potential for permanent spawning areas in this reach is not without risk. The bypass reach serves as a spill channel and has passed flows as high as 44,700 cfs in the 1996 flood. Flows of this magnitude scour the channel of much of the spawning gravels and could eliminate bull trout redds.

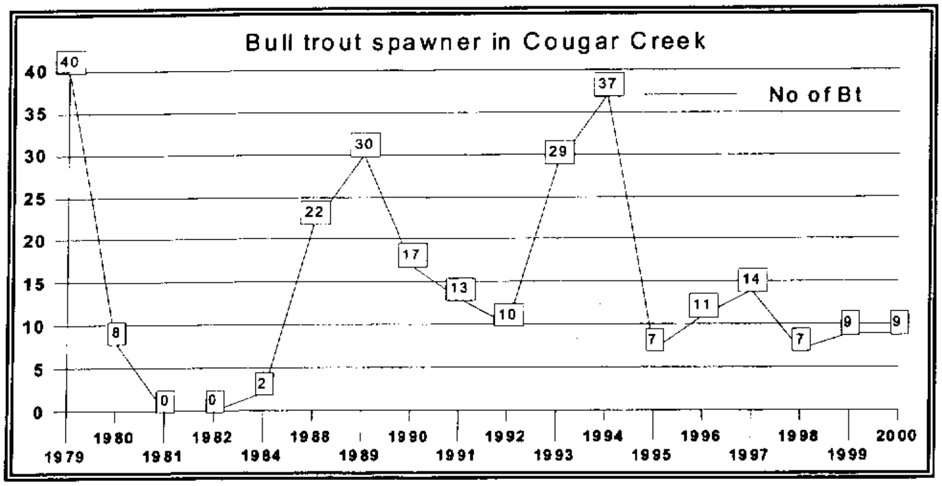
Spawning ground surveys conducted since 1988 in Cougar Creek are so variable it is impossible to establish a trend (See Figure 1). The status of the Yale Reservoir subpopulation is considered

Figure 1: Recent Bull Trout Spawning Estimates in Cougar Creek



to be depressed with an unknown trend (USDI 1998a). Spawning bull trout were observed in the Swift bypass reach in 1979, 1981 and 1982 (Graves 1979; Graves 1983). It is assumed that these fish spawning in the bypass reach were part of Yale Reservoir although it is possible that these fish may have been Swift Reservoir fish that were isolated in Yale due to entrainment during spill or through the turbines of Swift 1 and Swift 2. Juvenile fish were found in the Siouxon and Cougar Creek inlets (Graves 1983). The size of these fish ranged upward from 0+ fish at 152mm. Historical creel census data collected in Yale (Figure 2) show a steady decline in the number of bull trout caught (Graves 1983). This decline may be an indication that the actual population was declining even as far back as 1978.

Figure 2: Historical Creel Census of Bull Trout Harvest in Yale Lake



The Swift Reservoir fish spawn in Pine and Rush Creeks (WDFW 1998). Radiotelemetry studies conducted on bull trout in Swift Reservoir indicate that migrating adults use both Rush and Pine creeks with no evidence of reproductive isolation. Bull trout distribution is limited to the lower 1.6 km (1.0 mi) of Rush Creek due to an impassable falls, and the expansion of bull trout range within other tributaries in the upper watershed may be limited by unsuitable temperature regimes (Faler and Bair 1996). Recent spawning surveys on Pine and Rush Creeks show a possible upward trend in population size but the variability of the data makes this determination difficult.

Unlike the Yale Reservoir fish, bull trout in Swift Reservoir have a larger spawning area and connectivity between spawning grounds (Pine and Rush creeks), which may buffer these fish against stochastic events. For example, after the 1980 eruption of Mt. St. Helens when habitat throughout the Pine Creek drainage was severely altered (Faler and Bair 1996), migratory bull trout from Swift Reservoir subsequently recolonized Pine Creek. The status of the Swift Reservoir bull trout is considered to be depressed with a stable trend (USDI 1998a).

Habitat Conservation Plans (Columbia River DPS)

The status of the bull trout has been influenced by the WDNR HCP that was prepared in conjunction with incidental take permit applications to the FWS pursuant to section 10(a)(1)(B) of the Act. The amendment to the WDNR HCP specifically addresses bull trout and lands covered by this HCP are within the vicinity of proposed project. The WDNR's HCP amendment (USDI 1998b) to include bull trout allowed for incidental take of bull trout associated with habitat degradation/loss due to 29 miles of road construction and maintenance per year and 158 acres of selective and thinning harvest per year. This amendment added only the Coastal-Puget Sound DPS of bull trout and that portion of the Columbia River DPS west of the Cascade Crest to the WDNR's HCP. Eastside Columbia Basin tributaries were not included.

COASTAL CUTTHROAT TROUT STATUS (Action Area)

A population of coast cutthroat trout is present in the East Fork Lewis River, although not abundant. This information is based on angling reports, occasional sightings, and from fish trapped on the Cedar River, a tributary to the Lewis River (Rawlings 1999). Coastal cutthroat trout are also known to utilize Manson and Mill Creeks, tributaries to the East Fork Lewis River (Rawlings 1997) in the vicinity of the proposed action. In general, coastal cutthroat trout are believed to migrate up to Lucia Falls (RM 21.3) in most years, and passage above the falls and access to habitat above the falls is possible during severe flooding. These fish can also be found in many of the tributary streams below Lucia Falls (WDFW 2000). We believe that Dean Creek which flows along the west boundary of the Storedahl property hosts coastal cutthroat trout. Limited spawning and rearing habitat may occur in Dean Creek but seasonal low or subsurface flows probably limits full utilization of Dean Creek by coastal cutthroat trout. Cutthroat trout have been observed in Dean Creek but no determination of whether these fish are resident or anadromous trout has been made. Coastal cutthroat trout are not expected to spawn in the mainstem East Fork Lewis River in the vicinity of the Daybreak Mine. This reach would provide some juvenile rearing and adult foraging habitat.

PACIFIC LAMPREY STATUS (Action Area)

The Pacific lamprey can be found in coastal streams from California to Alaska (Morrow 1976). Pacific lamprey are native to the Columbia River and were historically abundant (Jackson *et al.* 1996). No comprehensive surveys have been conducted for Pacific lamprey in the East Fork Lewis River including the reach adjacent to the Storedahl Daybreak Mine site. However, the East Fork Lewis River is within the known range of the species and suitable spawning, rearing, and migrating habitats do exist in the East Fork Lewis River. Lamprey (species unknown) were observed spawning in the reach of the East Fork Lewis River that flows through the Ridgefield gravel mining pits, just upstream of the 1.25 mile reach of spawning habitat below the Daybreak Mine site (R2 Resources 2000). This observation occurred during a night survey of juvenile salmonid in the Ridgefield pits conducted by R2 Resources accompanied by staff from the Services. On other systems, Pacific lamprey have been observed during steelhead spawning surveys and appear to use similar spawning habitat (Jackson *et al.* 1996; Foley 1998). Based on these observations, suitable spawning habitat for lamprey in the East Fork Lewis River mainstem could extend from the end of the tidal influence zone (RM 6.0) to Sunset Falls (RM 31.5). It is assumed that the East Fork Lewis supports spawning, rearing and migrating river lamprey. Limited spawning and rearing habitat may occur in Dean Creek but seasonal low or subsurface flows probably limits full utilization of Dean Creek by Pacific lamprey.

RIVER LAMPREY STATUS (Action Area)

Little information exists on the occurrence of river lamprey in the Lewis River Basin of the East Fork Lewis River. However, the Lewis River and East Fork Lewis River are within the known range of the species, and suitable freshwater habitat for the river lamprey occurs in the East Fork Lewis River and within close proximity to the Storedahl Daybreak Mine site. Lamprey (species unknown) were observed spawning in the reach of the East Fork Lewis River that flows through the Ridgefield gravel mining pit, just upstream of the 1.25 mile reach of spawning habitat below the Daybreak Mine site (R2 Resources 2000). This observation occurred during a night survey of juvenile salmonid in the Ridgefield pits conducted by R2 Resources accompanied by staff from the Services. On other systems, Pacific lamprey have been observed during steelhead spawning surveys and appear to use similar spawning habitat (Jackson *et al.* 1996; Foley 1998). Based on these observations, suitable spawning habitat for lamprey in the East Fork Lewis River mainstem could extend from the end of the tidal influence zone (RM 6.0) to Sunset Falls (RM 31.5). It is assumed that the East Fork Lewis supports spawning, rearing and migrating river lamprey. Limited spawning and rearing habitat may occur in Dean Creek but seasonal low or subsurface flows probably limits full utilization of Dean Creek by river lamprey.

OREGON SPOTTED FROG STATUS (Action Area)

Historically, the Oregon spotted frog ranged from southwestern British Columbia to the northeast corner of California, including the Puget Sound lowlands, Willamette Valley, and the Cascade Mountains of south-central Oregon. The Oregon spotted frog has been extirpated from almost all of its historic range west of the Cascade Mountains and in the Puget Trough in Washington including Clark County. Only five small, disjunct populations of Oregon spotted frogs are known to be present in Washington at the present time. Two of these populations are located in Klickitat County and three populations are located in Thurston County.

An amphibian survey in Clark County conducted in February of 1998 found several egg masses thought to be that of Oregon spotted frogs. One of these egg masses was found on the Storedahl Daybreak Mine site (Corkran 2000). During the survey, five eggs were collected for rearing and identification purposes from the egg mass found on the Storedahl Daybreak Mine site. Positive species identification could not be made from these samples. A subsequent survey for tadpoles and adults by Clark County and WDFW personnel failed to observe any Oregon spotted frogs within Clark County (McAllister 1999). On a follow-up survey in May of 1999, potential Oregon spotted frog eggs were collected from a site approximately 2 miles south of the Storedahl Daybreak Mine site. However, DNA testing revealed the eggs to be those of the common red-legged frog (Corkran 2000). Currently, no evidence suggests that Oregon spotted frogs occur at the Daybreak Mine site or in Clark County. However, the project site does contain small, fragmented wetland habitat and permanent wetlands which provide favorable habitats for Oregon spotted frogs are found in the action area. Consequently, we believe that over the permit term Oregon spotted frogs have a likelihood of colonizing the Daybreak Mine site.

EFFECTS OF THE ACTION

The "effects of the action" is defined in the ESA section 7 implementing regulations as:

> "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline. Indirect effects are those that occur later in time, but that are reasonably likely to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration." (50 CFR §402.02).

The following actions are covered by the HCP and ITP:

- gravel mining and attendant activities outside the 100-year floodplain (FEMA 2000);
- gravel processing including the use of flocculants and coagulants;
- site reclamation activities including, but not limited to, the creation of emergent and open water wetland habitat, narrowing and shallowing of existing ponds, riparian and valley-bottom forest restoration, habitat rehabilitation, riparian irrigation, and low flow augmentation of Dean Creek; and
- implementation, monitoring, and maintenance of all conservation measures in the final HCP.

Gravel Mining

Mining of the Daybreak Mine site would occur on approximately 178 acres of Storedahl-owned lands to the north and east of the existing five ponds, with gravel extraction limited to approximately 101 acres of land outside the 100-year floodplain (FEMA 2000). The expansion of the Daybreak Mine site would proceed as a series of open excavations immediately followed by reclamation activities. Surface overburden would be removed using bulldozers and pan scrapers to expose the aggregate. All topsoil and overburden would be separated and temporarily stockpiled for use in reclamation to enhance forest and riparian habitats. Reclaimed areas will be revegetated using native species per CM-06 and CM-07 and non-native, evasive species will be controlled per CM-06, CM-07, and Appendix B of the HCP. Aggregate would be excavated using a trackhoe excavator and/or dragline. The excavation of gravel and sand would create ponds that are anticipated to have an average depth between 25 and 35 feet below the original groundwater level. Final configuration of the excavated areas would comply with conservation measures in Chapter 4 of the final HCP. For a complete description of gravel mining refer to the Final HCP (Sweet *et al.* 2003) and EIS (USFWS and NOAA Fisheries 2003).

Mining would progress in phases, with reclamation and habitat enhancement implemented sequentially on each phase. Seven mining phases are planned; each phase is expected to take approximately 1 to 3 years to complete depending on market demand for gravel and the capacity of the processing plant. Mine expansion would be sequenced to minimize impacts to neighboring properties and to expedite conservation measures deemed important to minimize avulsion risks and enhance habitat at the site. Under the final HCP, mining activities would proceed in the following manner:

- narrowing and shallowing of the existing Daybreak Mine Ponds 1, 2, 3, and 4 would begin in the first year of HCP implementation to minimize the magnitude and longevity of an avulsion into the existing ponds;

- noise attenuation berms, sound walls, and visual buffers would also be established in the first year and subsequent years, along with the reforestation of all areas not planned for mining (approx. 73 acres);

- Phase 1A and 1B would be excavated and reclaimed early in the mining sequence in order to establish the riparian management zone along Dean Creek specified in CM-13 (Sweet *et al.* 2003);

- Phases 2 and 3 in the mining sequence are located in the eastern portion of the Storedahl property and separated from the rest of the property by NE 61st Avenue. These two phases would take approximately two to three years to complete and would be completed three to five years after the ITP is effective and mining is initiated. Transportation of materials mined from these phases would be via conveyor system and/or trucks. Reclamation of these areas would run concurrently with mining; and

- after Phase 3 is completed, a conveyor system would be relocated to the main parcel and mining would commence on Phases 4 and 5. Once these phases are completed, mining of the final two phases (6 and 7) would commence. The reclamation of these four areas and the construction of associated wetlands would begin during mining and be completed soon after the mining of each phase is completed. In all, the mining of phases 4 through 7 is anticipated to take between 6 and 10 years, and occur within 10 to 15 years following ITP issuance/implementation.

The proposed gravel excavations would result in five ponds and 10 small wetlands. Unexcavated lands adjacent to the ponds and wetlands would be forested once contouring, regrading, and supplementation with reserved topsoil have occurred. A major goal of reclamation under the HCP is the establishment of a mixed forest vegetative community that provides shade along riparian areas and adjacent to created wetlands, provides habitat for fish and wildlife, increases soil stability, resists erosive forces, and provides some protection against an avulsion (Sweet *et al.* 2003). Reclamation is planned to be sequential to and concurrent with mining activities and would occur in areas not impacted by mining activities and as soon as all necessary permits including the ITP are obtained. This would allow 10 to 15 years for established trees to mature on some portions of the property while mining and reclamation activities on other areas was proceeding. Following the sequential completion of each phase, or at the completion of all mining, reclamation, and habitat enhancement activities, Storedahl would establish conservation easements with appropriate deed restrictions that would provide for the long-term protection and maintenance of fish and wildlife habitat on the Daybreak Mine site. Storedahl would, with the consultation and consent of the Services, deed the entire property to a non-profit conservation groups (s) whose goals and purposes are to conserve and enhance fish and wildlife habitat.

Gravel Processing

The Daybreak Mine site includes a gravel-processing area (approx. 23 acres) which, until recently, had been used to process gravel brought in by truck from other nearby sources. The processing area includes the Storedahl Pit Road, storage areas for excavation equipment, aggregate processing equipment, raw material, processed sand and gravel, stockpiles, fuel storage tanks, water treatment supplies and equipment, parking areas, temporary haul roads, an office, scales, and a maintenance shop.

Historically, Storedahl used a series of settling ponds to control turbidity generated by the wet-processing of aggregate at the Daybreak Mine site. This passive process took advantage of long detention and settling times in order to meet NPDES permit requirements (50 NTUs) at the discharge compliance point. However, during times of high precipitation and large aggregate processing volumes, this system resulted in turbidity levels approaching the 50 NTUs permit limitations. This common method of reducing turbidity provided little opportunity to increase facility capacity or improve water quality discharge parameters. In May of 1999, after consultation with Ecology, Storedahl experimented with a water treatment system to improve settling time and the quality of discharge water. First, process water was released into a long, sinuous channel to settle out the heaviest materials. Next, chemical additives were employed to improve settling efficiency before water entered Pond 1 where further settling occurred. Water then flowed into Pond 2 where it was either picked up for reuse in the processing operation or passed onto Pond 3 and then into Pond 5 for additional settling before being discharged into Dean Creek. Pond 4 is a small, isolated pond and not part of the past or future gravel processing operations. This method was used from May 1999 to May 2001 with notable success by substantially reducing NTU levels below the NPDES permitted level of 50 NTUs.

Under a commitment (CM-01) in the final HCP (Sweet *et al.* 2003), Storedahl would continue to process gravel using the water treatment system described above until a closed-loop system can be developed, tested, and permitted. It is anticipated that this closed-loop system will be fully implemented in three years. Implementation of the closed-loop system would eliminate the need to discharge process water and suspended sediments from gravel processing into the existing ponds and subsequently to Dean Creek and the East Fork Lewis River.

The closed-loop treatment system implemented at the Daybreak Mine site would contain the following or similar components to achieve the objectives of CM-01:

- pre-settling basin or tank that will remove coarser solids such as sand from the wash water;

- flocculent/coagulant injection system consisting of an additive storage tank or drum and a metering pump. A mixing tank may be required for sufficient contact between the wash water and additive. The purpose of the additive is to enhance the formation of floc particles and separation of solids from the wash water;

- clarifier necessary to settle out flocculated materials. The clarifier will have a continuous solids removal system to clean sediment from the clarifier; and

- belt press, or similar system, will be used to decrease water content in the sediment. Water from the belt press will be re-circulated to the system and the material will be stockpiled for further drying before use in reclamation.

Three monitoring measures (MEM-01, 02, and 03) would be implemented to ensure that the water discharged from the Daybreak Mine ponds to Dean Creek and, subsequently, the East Fork Lewis River is non-toxic to covered species, has a pH between 6.0 and 9.0, achieves turbidity levels less than 25 NTUs, has less than 40mg/l total suspended solids, has sufficient dissolved oxygen to support fish life, and has water temperatures at or below that of Dean Creek. If these criteria are not met, management responses are specified in the HCP, including preventing discharge of pond water to Dean Creek and halting wet-process operations until corrective measures are taken and the criteria can be achieved.

Site Reclamation

Much of the site is currently relatively flat, agricultural lands used for pasture and for row crops such as corn. Portions of the site are forested; however, these areas can be characterized as relatively small, disturbed patches. Only four small wetlands are within the proposed mining area (Ecological Land Services 1998). Three of the four wetlands will be avoided, while one 0.25-acre wetland would be excavated.

Prior to the beginning of the mining expansion, approximately 8 acres of existing forested lands would be preserved, 20 acres of previously planted land would be maintained and placed under a conservation easement, and an additional 53 acres of land would be planted with native valley bottom trees and understory shrubs. An additional 24 acres of forested wetlands and riparian habitat south of the existing haul road and west of the existing Pond 5 would be preserved. Areas that are mined would be reclaimed at the end of each mining phase. Following mining and reclamation activities, approximately 33 acres would be replanted as valley-bottom forest with understory shrubs. An additional 6 acres of forested wetland and riparian habitat would be created along Dean Creek. Approximately 22 acres of forested wetlands would be created as the existing Ponds 1 through 4 are narrowed and reclaimed. Along the edges of the new ponds, 32 acres of emergent wetlands would be created and 1 acre would be preserved. Also, following reclamation activities, 64 acres of open water spread across seven ponds would remain in the proposed expansion area and 38 acres of open water would remain in the reconfigured existing ponds. In all, reclamation activities would result in the creation, preservation, and restoration of 114 acres of forest, 52 acres of forested wetlands, 32 acres of emergent wetlands, and 102 acres of open water on the 300-acre Storedahl-owned property (see Table 1).

Table 1. Existing and final land cover types at the Daybreak Mine site.

	Existing Land Cover(acres)	Final Land Cover (acres)
Agriculture	101	
Upland (non-forested)	58	
Processing Area	23	
Restored Area	20	
Upland Forest	8	114
Forested Wetlands	24	52
Emergent Wetlands	2	32
Open Water	64	102

The typical sequence of mining and reclamation activities would be as follows:

- remove temporary berms, buffers, and stockpiles as needed to construct restoration features;
- use dewatered sediments and/or imported clean fill to create stable cores of restoration elements such as islands or wetlands. Smooth and contour slopes to provide irregular shorelines and gradual slopes around ponds and wetlands;
- construct hydraulic structures to route and control water flow through ponds;
- redistribute stockpiles of topsoil to provide a growing medium for plantings;
- plant and seed reclaimed areas according to CMs 06, 07, 13, and 15 and monitor to ensure success (MEM-05); and
- use clean fill material brought in from off-site locations and stockpiled fines and topsoil from mining and processing activities to reshape, narrow, and fill portions of existing Ponds 1, 2, 3, and 4. This fill, once supplemented with topsoil, will be re-vegetated with native wetland emergent plants and trees. Up to 300,000 cubic yards of clean fill material will be imported to minimize the footprint and depth of the existing ponds, in order to minimize recovery time of the East Fork Lewis River in the event of an avulsion.

The following effects analysis is organized by individual covered species for effects resulting from gravel mining, gravel processing (exclusive of effects of flocculants and coagulants), and site reclamation activities. These effects can be categorized as the effects of sediment, temperature effects, effects to groundwater and the hyporheic zone, and habitat effects, where appropriate. Subsequent sections in the effects analysis address the effects of using flocculants and coagulants as additives to the gravel processing operations on covered species and the effects of an avulsion on covered species. In addition, only the CMs related to the species being analyzed are included in the analysis of that species.

Effects of Gravel Mining, Gravel Processing, Site Reclamation and Associated Conservation Measures on Covered Species

Bull Trout

The only bull trout population in the vicinity of the Daybreak Mine site resides in the upper Lewis River. This population is an adfluvial population located upstream of a series of three dams: Merwin, Yale, and Swift. These dams restrict the upstream migration of bull trout. There is limited downstream movement of this population, and fish that pass through one of the dams can not return upstream. Bull trout in Yale and Swift reservoirs have access to suitable spawning habitat, while fish that occur in the lowest reservoir (Merwin Reservoir) do not have access to suitable spawning habitat. Fish that pass through Merwin Dam have access to the lower Lewis River and potentially the East Fork Lewis River. In addition, bull trout in the lower Columbia River may also stray in and out of the lower Lewis River system including the East Fork Lewis River. Warm water temperatures in the East Fork Lewis River system are not suitable for bull trout egg incubation and/or juvenile rearing and, therefore, no self-sustaining population is anticipated to be present in this system. The Lower Columbia Recovery Unit Team of the Draft Bull Trout Recovery Team identified two core areas (Lewis and Klickitat) within the recovery unit. The Lewis Core Area includes the mainstem Lewis River and tributaries downstream to the confluence of the Columbia River, with the exclusion of the East Fork Lewis River (FWS 2002b).

Minimization and Mitigation Measures Benefiting Bull Trout

Several conservation measures committed to in the final HCP, directly or indirectly, minimize and mitigate potential impacts of covered activities to bull trout. CM-01 commits Storedahl to the installation and operation of a closed-loop wash water clarification system by year 3 of HCP implementation. The purposes of the closed-loop system are to 1) substantially reduce or eliminate discharges of turbid process water and effectively eliminate the discharge of process water to receiving waters (existing ponds) and Dean Creek, and 2) precipitate dissolved phosphorous and increase the transparency of the pond water. This should result in a decrease in algal growth, subsequently decreasing the decomposition of organic matter and increase DO levels in the ponds. The closed-loop system would remove solids from the process water and re-circulate the process water back to the aggregate processing system. Solids removed from the closed-loop system would be run through a belt press, or similar system, to further reduce moisture content. Solids would be stored on the Daybreak Mine site to dry further and then eventually be incorporated into reclamation actions. Process water from the belt press would be re-circulated back to the aggregate processing system for reuse. All water used to wash the gravel would be recycled, reducing the demand for water. Relatively small amounts of water would be needed to occasionally recharge the closed-loop system. The closed-loop system would also substantially reduce or eliminate the need to discharge water into the existing ponds as previously required during washing operations. This, in turn, would greatly reduce the amount of suspended sediment and high levels of turbidity in the ponds that were common under the previous washing operations. Implementation of CM-01 would indirectly benefit bull trout when they occur near the Daybreak Mine Site, by improving the quality of water on site and the quality of the water subsequently discharged into Dean Creek and, subsequently, the East Fork Lewis River.

CM-02 commits Storedahl to implement a comprehensive storm water/surface water and erosion control plan as well as a storm water pollution prevention plan to minimize adverse impacts to water quality as a result of mining and reclamation activities. This CM is designed to manage storm water and surface water runoff and potential sources of water contamination on site, before these potential sources of turbidity, suspended sediments, and pollutants can enter Dean Creek or the East Fork Lewis River and negatively affect water quality. This measure includes 1) isolating impacts to surface water from mining and reclamation activities, 2) containing and pre-treating surface runoff, 3) re-vegetating bare soils, 4) preventing and managing oil and fuel spills, 5) installing a conveyor to transport mined aggregate, 6) maintaining surfaces on active roads, 7) having a water truck and street sweeper on site, as needed, 8) decommissioning unused haul roads, and 9) specifying in advance conditions that would result in a suspension of operations due to water quality concerns. Implementation of CM-02 would indirectly benefit bull trout by improving water quality of on-site water and the quality of water discharged to Dean Creek and, subsequently, the East Fork Lewis River.

Storedahl would immediately donate 237 afy of water rights on the property to the State Trust for the enhancement of instream flows in the East Fork Lewis River and (CM-03). All water rights associated with the property (330 afy) would be donated to the State Trust, in perpetuity, for instream flow enhancement at the completion of processing operations or the term of the ITP, whichever comes first. Flows in the East Fork Lewis River vary seasonally, with the lowest flows usually occurring during the summer months prior to the onset of fall rains. Donating water rights to the State Trust for the enhancement of instream flows would indirectly benefit bull trout by improving base flow conditions of the lower East Fork Lewis River during critical low flow periods.

CM-04 is intended to manage the discharge of pond water to provide seasonal benefits to Dean Creek and to prevent Dean Creek from entering Pond 5 during periods of high flows. By managing the release of pond water and preventing Dean Creek from over flowing into Pond 5 during most high flow events (floods less than a 17-year return period), water quality, including water temperatures, will be improved.

Under CM-05, Stordahl will establish a conservation and habitat enhancement endowment up to 1 million dollars plus earnings for the monitoring, habitat enhancement, and management of the 300-acre property after the completion of all site reclamation activities. In association with the endowment, Storedahl will grant a perpetual conservation easement on the entire property and convey the property in fee title to one or more conservation-minded groups. These commitments will ensure that reclamation measures implemented under the HCP will be maintained and managed in perpetuity for the benefit of all covered species.

Under CM-06 Storedahl would establish native forest on unforested areas within the 100-year floodplain (FEMA 2000), along existing and created ponds, and on upland areas. Initial plantings would occur immediately upon issuance of an ITP and other necessary permits, and the remaining plantings would be part of the reclamation activities. In total, 136 acres would be planted with trees providing a future source of shade, soil stability, detrital inputs, and large and coarse woody debris. Implementation of CM-06 would indirectly benefit bull trout by enhancing riparian conditions adjacent to and in the floodplain of the East Fork Lewis River.

Under CM-08 and 09, Storedahl would incorporate mining and reclamation designs that would reduce the risk of an avulsion into the existing ponds and the expanded mine area. These designs would also minimize the effects of an avulsion and the recovery time of the East Fork Lewis River if an avulsion were to occur. All expanded mining would be outside the 100-year floodplain (FEMA 2000), approximately 86 percent of the excavated area would be outside of historic channel locations, as defined by 150 years of observations (Collins 1997), and/or separated from the East Fork Lewis River by established and regularly maintained roads. The existing ponds would be reclaimed to create a wider, vegetated buffer between the existing ponds and the East Fork Lewis River. In addition, the existing ponds would be narrowed and shallowed to reduce geomorphic recovery time should an avulsion occur in the future. Storedahl Pit Road will also be upgraded to protect against an avulsion entering Pond 1. Implementation of CMs-08 and 09 could indirectly benefit bull trout by minimizing the potential for and the effects of an avulsion on fish habitat in the East Fork Lewis River.

Under CM-11, Storedahl would provide labor, equipment, and/or materials in cooperation with public or non-profit groups to enhance East Fork Lewis River floodplain functions and fish habitat related to the protection and recovery of covered species. Although these services may not be specifically directed at improving bull trout habitat, enhancement efforts in the lower reaches of the East Fork Lewis River could indirectly benefit bull trout by improving habitat in and adjacent to the East Fork Lewis River and/or its tributaries.

CM-16 indirectly benefits bull trout by committing Storedahl to proactive measures to eliminate or control the number of non-native predatory fish by removing fish that reside in the existing ponds and by placing educational signs informing the public of the dangers of releasing non-native fish into ponds adjacent to streams, rivers, and wetlands. Non-native predatory fish that are allowed to live and mature in the existing or new ponds could potentially compete with adult and subadult bull trout for prey. These fish, including large mouth bass, have either entered the Storedahl ponds during flooded conditions or were intentionally introduced for the purposes of fishing. Regardless of their origin, these predatory fish pose a threat to all salmonids if allowed to proliferate unchecked in the existing ponds or if purposefully stocked into the new ponds.

Non-native fish are known to occur in Pond 5 and it is probable that they also occur in some, if not all, of the remaining four ponds. As part of CM-16, targeted harvest of non-native predatory fish in the existing ponds would occur in years 5, 10, and 15 to reduce their numbers. Rock barriers between ponds would also be constructed and maintained to prevent these fish from moving between ponds. In an attempt to inform fishermen of the negative consequences of introducing non-native predatory fish to the existing ponds or the new ponds, educational signs would be erected. Signs would be placed in plain view and would warn the public about the dangers to native fishes posed by the introduction of non-native fish to the ponds. CM-08 would also indirectly affect the numbers of non-native predatory fish by narrowing, reshaping, and shallowing the existing ponds. Although this measure was designed to address avulsions, it also would eliminate much of the deep, open water habitat in the existing ponds currently utilized by non-native predatory fish. Reducing the numbers of non-native fish and the habitats on which these non-native fish depend will benefit bull trout by removing a potential source of competition for prey species.

Effects of Sediment on Bull Trout

Gravel mining would be conducted on 101 acres of agricultural lands above the 100-year floodplain (FEMA 2000). The excavation of commercially desirable gravel requires the removal of overburden including topsoil and culled aggregate material that is not suitable for processing. These materials would be separated and temporarily stored on site and used in the reclamation of the site. Reclaimed areas will be revegetated using native species per CM-06 and CM-07, and non-native, evasive species will be controlled per CM-06, CM-07, and Appendix B of the HCP. Once the overburden is removed, gravels and associated fines would be mined with a trackhoe or dragline and transported by conveyor or truck to the processing area. The sources of gravel identified at the Daybreak Mine site contain very low amounts of fine sediments (roughly 2 percent). A total of approximately 400,000 cubic yards or 1 million tons of gravel would be mined per year resulting in approximately 8,000 cubic yards or 20,000 tons of fines per year. Fines would also be generated when gravels from off-site sources are transported to the Daybreak Mine site to be processed. Storedahl has historically imported 300,000 cubic yards per year of pre-screened material to the Daybreak Mine site for processing. This pre-screened material includes approximately 4 percent fines. Assuming on-site aggregate and imported off-site materials were both processed at the site, the amount of fines projected to be generated annually from this activity would be approximately 20,000 cubic yards (30,000 tons). Fines generated by gravel processing and topsoil and overburden excavate during mining will be used for reclamation activities. Up to an additional 300,000 cubic yards of clean fill will be transported from off-site locations to the Daybreak Mine site to be used in the reclamation of the existing ponds per CM-08.

The fines from the above mentioned sources, when allowed to enter the Dean Creek or East Fork Lewis River, could negatively impact habitat below the Daybreak Mine site, in turn, adversely affecting any foraging bull trout in the East Fork Lewis River below the Daybreak Mine site directly and through impacts to prey, as described below. Gravel processing during the first three years will result in process water being discharged into Pond 1 and the existing ponds will be used for settling. In addition, during active mining operations the existing ponds will be used to treat surface water runoff during storm events.

Bull Trout Prey Base Effects: Bull trout are apex predators that prey on a variety of species including terrestrial and aquatic insects and fish (Reiman and McIntyre 1993). The three main families of insects that bull trout are known to utilize as prey include Ephemeroptera (mayflies), Trichoptera (caddisflies), and Plecoptera (stoneflies) (Waters 1995). Fish are also common in the diet of bull trout that are 110 millimeters (mm) or longer. Large bull trout may feed almost exclusively on fish. An increase of sediment inputs into the East Fork Lewis River could adversely affect the spawning of Chinook and coho salmon, cutthroat trout, and steelhead, thereby, indirectly affecting bull trout by reducing prey levels. Increases in turbidity could also negatively affect the numbers and distribution of invertebrates.

Turbidity and suspended solids can affect macro-invertebrates in multiple ways: increased invertebrate drift, feeding impacts, and loss of habitat. The effect of light reduction from turbidity has been well documented and results in increased invertebrate drift (Waters 1995). This may be a behavioral response associated with the night-active diel drift patterns of macro-invertebrates. While increased turbidity results in increased macroinvertebrate drift, it is thought that the overall invertebrate populations would not fall below the point of severe depletion (Waters 1995).

Increased suspended sediment can also affect macro-invertebrates by abrasion of respiratory surface and interference of food uptake for filter feeders (Birtwell 1999). Increased suspended sediment levels tend to clog feeding structures and reduce feeding efficiencies, which result in reduced growth rates, increased stress, or death of the invertebrates (Newcombe and MacDonald 1991). Invertebrates living in the substrate are subject to scouring or abrasion, which can damage respiratory organs of aquatic insects (Bash *et al.* 2001).

Benthic invertebrates inhabit the stream bottom. Therefore, any modification of the streambed by deposited sediment would most likely have a profound effect upon the benthic invertebrate community (Waters 1995). Increased sediment can affect macroinvertebrate habitat by filling of interstitial space. The degree to which substrate particles are surrounded by fine material was found to have a strong correlation with macroinvertebrate abundance and composition (Birtwell 1999). At an embeddedness of one-third, insect abundance can decline by about 50 percent, especially for riffle-inhabiting taxa (Waters 1995).

Increased suspended sediment and turbidity can also affect feeding, growth rates and, therefore, reproductive capability of invertebrates in two ways: decreased prey abundance and a decline in feeding efficiency. In streams, increased turbidity results in decreased light penetration into the water column (Lloyd *et al.* 1987). This results in decreased photosynthesis and, therefore, reduced primary production (Waters 1995). Macroinvertebrate populations (secondary production) depend upon primary production for food, especially in fourth to sixth order streams (Vannote *et al.* 1980). Decreased photosynthesis and primary production, as well as the direct impact from sedimentation, can decrease macro-invertebrates available to foraging bull trout. Decreases in invertebrate production can also indirectly affect foraging bull trout by decreasing the food base that supports other bull trout prey species.

The physical implications of sediment in streams include degradation of spawning and rearing habitat, damage to habitat structure, and loss of habitat for prey species. Biological implications of this habitat damage include underutilization of stream habitat, abandonment of traditional spawning habitat, displacement of fish from their habitat, and avoidance of habitat (Newcombe and Jensen 1996). As sediment enters a stream it is transported downstream under normal fluvial processes and deposited in areas of low shear stress (MacDonald and Ritland 1989). These areas are usually behind obstructions, near banks (shallow water), or within interstitial spaces. This episodic filling of successive storage compartments continues in a cascading fashion downstream until the flow drops below the threshold required for movement or all pools have reached their storage capacities (MacDonald and Ritland 1989). As sediment load increases, the stream compensates by geomorphologic changes in increased slope, increased channel width, decreased depths, and decreased flows (Castro and Reckendorf 1995). These processes also contribute to increased erosion and sediment deposition, which further degrade salmonid habitat.

The addition of fine sediment (less than 6.4 mm) to natural streams during summer decreased abundance of juvenile Chinook salmon in almost direct proportion to the amount of pool volume lost to fine sediment (Bjornn *et al.* 1977). Similarly, the inverse relationship between fine sediment and densities of rearing Chinook salmon indicates the importance of winter habitat and high sediment loads (Bjornn *et al.* 1977). As fine sediments fill the interstitial spaces between the cobble substrate, juvenile Chinook salmon, in the Red River in Idaho, were forced to leave preferred habitat and to utilize cover that may be more susceptible to scouring, predation, and decreased food availability (Hillman *et al.* 1987).

Reductions in the level of prey species can cause declines in the number of apex predators like bull trout. However, this in not anticipated to occur because few bull trout are expected to use the East Fork Lewis River to forage, and therefore, these bull trout are not likely to be limited by the availability of prey even if prey in the lower river is adversely affected by sediment. Furthermore, the East Fork Lewis River is outside of the Lewis Core Area as identified by the Draft Bull Trout Recovery Plan (FWS 2002b) and, subsequently, bull trout that forage in the East fork Lewis River are not needed for recovery.

Feeding Efficiency: Increased turbidity and suspended sediment can affect a number of factors related to salmonid foraging including feeding rates, reaction distance, and prey selection (Bash *et al.* 2001). Changes in feeding behavior are primarily related to the reduction in visibility that occurs in turbid water. Effects on feeding ability are important as salmonids must meet energy demands to compete with other fish for resources and to avoid predators.

Distance of prey capture and prey capture success both were found to decrease significantly when turbidity was increased (Berg and Northcote 1985). Waters (1995) asserts that loss of visual capability, leading to reduced feeding is one of the major sublethal effects of high-suspended sediment concentrations. Loss of visual capability leads to depressed growth and reproductive capability.

Sigler *et al.* (1984) found that a reduction in growth occurred in steelhead and coho salmon when turbidity was as little as 25 NTUs. However, this could have resulted from more than just a reduced ability to catch prey once detected, for example, it could have been from an inability to see prey (insufficient light, also an impact from increased turbidity). Redding *et al.* (1987) found that suspended sediment may inhibit normal feeding activity, which resulted from loss of visual ability or as an indirect consequence of increased stress. Turbidity from day-to-day gravel mining, gravel processing, and site reclamation activities are not expected to reach the East Fork Lewis River, and therefore, impacts to foraging bull trout are not anticipated to occur.

Physiological and Behavioral (sublethal) Effects: Sublethal levels of suspended sediment may cause undue physiological stress on fish, which may reduce the ability of the fish to perform vital physiological and behavioral functions. Although such stress may not be severe, it may reduce the ability of the fish to feed or resist exposure to disease and toxicants (Waters 1995). Redding *et al.* (1987) observed higher mortality in young steelhead trout exposed to a combination of suspended sediment (2.5 g/L) and a bacteria pathogen, than when exposed to the bacteria alone. Physiological stress in fishes may decrease immunological competence, growth, and reproductive success (Bash *et al.* 2001).

Increased turbidity and suspended sediment may result in behavior changes in salmonids. This includes avoidance, distribution, homing, and migration. Although an avoidance response may be an initial adaptive survival strategy, displacement could be detrimental. It is possible that the consequences of fish moving from preferred habitat to avoid increasing levels of suspended sediment may not be beneficial if displacement is to sub-optimal habitat, or if they become stressed and more vulnerable to predation. Turbidity from day-to-day gravel mining, gravel processing, and site reclamation activities are not expected to reach the East Fork Lewis River, and therefore, impacts to foraging bull trout are not anticipated to occur.

In summary, increased sediment loading in the East Fork Lewis River that occurs as a result of gravel mine expansion, could negatively affect bull trout due to impacts to foraging behavior, habitat degradation, food supply disturbances, and decreased water quality. Although these effects could be serious and would depend on the magnitude and duration of any sediment loading event, the effects of sediment generated by gravel mining activities on bull trout would be minimized by the conservation measures described previously. Commitments under the final HCP are designed to manage sediment and day-to-day gravel mining and processing activities that generate sediment on site, preventing sediment that would otherwise be harmful to bull trout from entering the East Fork Lewis River.

During the first three years of gravel processing under the HCP, gravel will be wet-processed via the method developed and tested on site from May of 1999 through June 2001. This system used flocculants and coagulants in conjunction with a settling channel and settling in the existing ponds to remove sediments from the wash water. Turbidity levels were tested regularly at the outlet to Dean Creek. NTU levels measured and recorded during this time period where at least one half the currently permitted level of 50 NTUs and were typically less that one-fifth of the currently permitted level or 10 NTUs (Sweet *et al.* 2003). Turbidity will be measured weekly per the NPDES permit at the point where Pond 3 over flows into Pond 5. The HCP specifies that turbidity at this point is not to exceed 25 NTUs. Although 25 NTUs will be the permitted level under the HCP, further reductions in turbidity are expected to occur from settling action in Pond 5 before water is discharged to Dean Creek. Discharges to Dean Creek during active gravel mining and processing are expected to occur on a daily basis only during October through June.

The closed-loop system, implemented after year three, will be designed to remove sediments from gravel without the need to discharge sediment laden or turbid water into the existing ponds. The final design of the closed-loop system will be developed in consultation with the Services and Ecology to ensure the intended results are achieved. The closed-loop system will effectively eliminate process water discharge to the ponds, but the ponds will continue to be used to settle out sediments derived from storm water and surface water runoff.

A SWPPP/ESC would be implemented to reduce sediments generated from storm water/surface water run-off events. Surface runoff from mining and reclamation activities are potential sources of suspended sediments and are in addition to sediments generated from gravel processing. Although sediments generated during gravel processing will be minimized via the closed loop clarification system, sediment generated during storm water runoff will not be processed in this manner. Instead, the SWPPP/ESC (Sweet *et al.* Appendix D 2003) is designed to prevent these sediments from entering Dean Creek or the East Fork Lewis River. Approaches summarized in CM-02 and further described in the SWPPP/ESC include minimizing the area susceptible to erosion, isolating active work areas, conducting mining and reclamation activities during May through September when surface water is typically not discharged to Dean Creek via Pond 5 outlet, using created ponds for settling and detention, and using conveyors to transport materials to reduce erosion and dust due to traffic on haul roads. The SWPPP/ESC also calls for the use of best management practices including seeding of exposed soils, road maintenance, and the use of silt fences, ditches, sediment ponds, and rock barriers to divert runoff from exposed soils.

The intended effect of wet-processing method used years 1 through 3, the closed-loop clarification system used years 3 through 15, and the storm water control measures used during the permit term is to reduce turbidity levels to one half or less of the currently permitted NTU level of 50 NTUs. Testing of wet processing system with chemical additives from June of 1999 through May of 2001 achieved turbidity levels below 5 NTU's with averages around 10 NTU's at the discharge point. A study conducted for the City of Redmond, Washington (Resources Planning Associates and HoweConsult 1999) tested the usefulness and practicality of four different cationic polymer compounds and processing designs for controlling turbidity at construction sites. Study results showed that polymer additives were effective at lowering turbidity to median levels of 4 to 11 NTUs. This discharge measurement, taken during testing of chemical additives at the Daybreak Mine site, encompassed both water originating from gravel process operations as well as storm water run-off. Installation of the closed-loop system and the implementation of the SWPPP/ESC are expected to achieve similar or better results with increased levels of water quality monitoring and toxicity testing. Effectiveness and toxicity will be monitored per MEM 01, 02, and 03 to ensure turbidity levels are being achieved and chemicals chosen are not toxic to covered species (See Effects of Inorganic Flocculants, Coagulants, and Polymers on Covered Species). Based on the NTU levels anticipated as a result of the implementation of the HCP and the distance water discharged from Pond 5 must travel through Dean Creek (1700 feet) to reach the East Fork Lewis River, adverse effects to foraging bull trout in the East Fork Lewis River from turbidity as a result of day-to-day gravel mining and processing are not expected to occur.

Sediments derived from the closed-loop system will be stockpiled above the 100-year floodplain (FEMA 2000) until they can be utilized for site reclamation activities. All reclaimed material will be vegetated to minimize the erosion of placed sediments. Sediments generated during gravel mining, gravel processing, and reclamation activities are only likely to enter the East Fork Lewis River during an avulsion event. The effects of an avulsion are discussed later in this section.

Effects of Temperature on Bull Trout

Because most aquatic organisms including salmonids are ectothermic (cold-blooded), water temperature plays an important role in regulating biological and ecological processes in aquatic systems. Temperature directly and indirectly affects physiology, development, and behavior of salmonids, as well as mediates competitive interactions, predator-prey relationships, and the incidence of parasitism and disease (Spence *et al.* 1996). Water temperatures significantly affect the distribution, health, and survival of native salmonids in the Pacific Northwest. Their survival is dependent on external water temperatures and they could experience adverse health effects when exposed to temperatures outside their optimal range (USEPA 2003). Almost all biological and ecological processes that affect salmonids are affected by ambient water temperatures (Spence *et al.* 1996). Adverse temperatures can affect growth, behavior, disease resistance, competition, and mortality (Sullivan *et al.* 2000).

Most of the literature on salmonid temperature requirements refers to "preferred", "optimal", or "tolerable" temperatures or temperature ranges (Everest *et al.* 1985, Bjornn and Reiser 1991). "Preferred" is used to describe the temperature to which, given unlimited acclimation time, a fish will ultimately gravitate towards (Spence *et al.* 1996). "Optimal" temperature range means the temperatures at which fish can best perform specific activities. The "tolerable temperature" range includes temperatures at which fish can survive indefinitely (Spence *et al.* 1996). A unique and well-documented facet of bull trout biology is the species requirement for cold water (Rieman and McIntyre 1993). While salmon require cold water, bull trout require a more narrow range of colder temperature conditions than other salmonids to reproduce and survive. These temperature requirements also vary by life cycle stages.

As stated earlier, the East Fork Lewis River does not support a spawning population of bull trout, as suitable spawning and rearing conditions do not exist in the East Fork Lewis River. Accordingly, no adult spawning migration is expected to occur, and therefore, juvenile bull trout are also not expected to be present. Adult and possibly, subadult bull trout, however, can enter the East Fork Lewis River via the Lewis River (fish that have been spilled over the dams) or from the Columbia mainstem (foraging fish from other river systems entering the Lower Columbia). Opportunistic fish from these sources are expected to use the East Fork River as foraging habitat only when conditions are suitable, i.e. forage present, water temperature suitable. Some literature suggests temperature requirements of foraging adult and subadult bull trout are similar to those required for juvenile rearing, while other work suggests that adults and subadults actually require lower water temperatures due to the stress of migration, spawning, and reproduction (EPA 2001).

Steve Elle and Dan Schill (Idaho Fish and Game) have conducted radio telemetry studies on bull trout in the Rapid River for several years. Some of the fish in the radio tag studies were subadults and others were spawning adults. Elle (1995) stated "water temperatures appear to have a major influence on upstream adult migration in the Rapid River, Idaho. During the early part of the run, the number of bull trout trapped coincides with temperatures of 10° C or higher... The other trend between temperature and migration indicates increased numbers of bull trout trapped with rising temperatures." When temperatures dropped below 10° C migrations slowed or stopped. From a table in the report it appears that the range of temperatures at which radio tagged bull trout were leaving over-winter locations to move upstream occurred mainly in the ranges of 9-12° C and 10-13° C. Downstream migration occurred in several pulses depending on size or spawning behavior of the fish. The fish sought thermal refuge in deep-water habitats upon entering the Salmon River. Schill *et al.* (1994) states "results from the few small fish we tagged suggest many fish less than 400 mm entering the Rapid River in the spring do not ascend the river to spawn. They may be ascending the Rapid River to avoid high temperatures in the main Salmon River during mid-summer."

In Swanberg's (1997) Blackfoot River bull trout radio telemetry study, bull trout migrations out of the mainstem river began during peaks in temperature which appeared to be cued by an increase in maximum daily temperatures. Non-spawning fish paused during migrations and "these pauses appeared to be related to periods of cooling." Non-spawning bull trout migrated to the lower portions of tributaries, or in a few cases, to the upper Blackfoot near an 8° C spring. It is unlikely that the primary purpose of the migrations was feeding since prey fish densities in tributaries were lower than in the Blackfoot River, but it appears to have evolved as a strategy to avoid seasonally unfavorable conditions in the Blackfoot River. Similarly, bull trout are likely to avoid entering the East Fork Lewis River when temperatures are unfavorable.

When establishing "upper" optimal temperature thresholds, it is important to consider a margin of safety, multiple stressors, and the risk associated with uncertainty. Subadult and non-spawning adults are more likely to locate and utilize cold water microhabitats and, therefore, may be able to tolerate stream temperatures of 16° C (EPA 2000) if such cold water refugia exist. Bull trout are not expected to occur in the East Fork Lewis River during the warmest times of the year.

Land use practices, such as gravel mining and processing, can have a measurable effect on stream temperatures. Riparian vegetation modifies convective and evaporation heat-exchange losses by creating a microclimate of relatively high humidity, moderate temperatures, and low wind speed. The wholesale loss of riparian vegetation through gravel mining, should it occur in riparian areas, can result in an increase in temperatures, increase in wind speed, and a decrease in humidity resulting in the transfer of heat energy to the stream (Spence *et al.* 1996). Stream temperatures may also increase due to the inputs of heated water from off-channel ponds created by gravel excavation (OWRRI 1995). The East Fork Lewis River in the vicinity of the Daybreak Mine site is a naturally wide, low elevation alluvial channel making it particularly susceptible to temperature impacts (Sullivan *et al.* 1990). Ecology lists the East Fork Lewis River on its 303(d) list as water quality impaired due, in part, to elevated water temperatures (Ecology 2001).

Summer water temperatures can exceed 22° C at the Daybreak Park, 2 miles upstream of the HCP area (Hutton 1995).

The majority of land surface proposed for mining under the HCP is agricultural and all the area is outside the 100-year floodplain (FEMA 2000), and therefore very few, if any, riparian trees would be removed. Instead, under the HCP, 24 acres of riparian forest and 8 acres of upland forest would be preserved. In the first year of the HCP, 20 acres would also be subject to a conservation easement perpetually protecting riparian and valley bottom forest. In addition, approximately 134 aces of mixed conifer and hardwood forest and riparian forest would be planted prior to and concurrent with mining and reclamation activities. Retention of existing forested areas, especially areas adjacent to or within the 100-year floodplain (FEMA 2000), would continue, albeit at a small scale, to modify convective and evaporation heat-exchange losses by creating a microclimate of relatively high humidity, moderate temperatures, and low wind speeds while providing a native seed source for future forests. The establishment of an additional 134 acres of forest over the term of the HCP would, over time, provide similar benefits and would have a net positive effect on surface and ground water temperatures.

However, 64 acres of new surface water would be created in the expanded mining area. This water would be exposed to the warming effects of direct sunlight and, during certain times of the year, could flow as surface water to Dean Creek and, subsequently, the East Fork Lewis River potentially increasing water temperatures of those water bodies. Implementation of CM-04 is intended to manage the discharge of Pond 5 to provide seasonal benefits to Dean Creek and prevent the release of warmer water during critical periods.

Surface-water discharge between and from the ponds will be controlled by site grading and pond construction. Surface outflow from Pond 5 will be restricted to a single location and controlled by the installation of a gravity-fed outlet structure at the northwest corner of Pond 5. This structure will be used to control pond levels and direct pond water discharge directly into Dean Creek during late fall, winter, and early spring when water temperatures in Pond 5 are within acceptable limits. Water temperatures in Pond 5 during this time period are typically 12°C or less. During warmer months (May through September), the gravity-fed outlet will be closed or is expected to be higher than pond surface water elevations. At this time, an average flow of 0.3 cfs will be pumped via a bottom water pick-up from stratified Ponds 3 and 5 into Dean Creek below J.A. Moore Road. Water temperatures of 12°C at the bottom of Ponds 3 and 5 have been measured in August and September. CM-04 should ensure that warm water from the existing or created ponds does not enter Dean Creek and subsequently the East Fork Lewis River, and cooler water from the bottom of Pond 5 is used to augment flows in Dean Creek during the summer. Therefore, adverse impacts to bull trout in the East Fork Lewis River from elevated surface temperatures in the existing or excavated ponds are not expected to occur.

Effects to Groundwater and the Hyporheic Zone on Bull Trout

Groundwater entering streams (especially small streams) is an important determinant of stream temperatures (Spence *et al.* 1996) and provides localized thermal refugia in stream systems in both summer and winter (Hayashi and Rosenberry 2002). Groundwater temperatures tend to be relatively constant at about the mean annual air temperature, whereas surface water temperatures often vary greatly, both daily and seasonally (Brunke and Gonser 1997). During the summer, groundwater inputs tend to be cooler than surface water, whereas in the winter groundwater is usually warmer than surface water. Therefore, as groundwater contributions increase, temperature variations in the surface stream tend to moderate (Jones and Mulholland 2000). During the summer, groundwater discharge areas typically provide refuge from excessively warm stream temperatures that may slow growth because the optimum physiological temperature range has been exceeded (Power *et al.* 1999). High temperatures also lower oxygen solubility and increase susceptibility of fish to bacterial infection (Dunne and Leopold 1978). Fish often move long distances to seek summer refugia offered by groundwater (Barton *et al.* 1985). Surface and groundwater exchanges in alluvial hyporheic zones can be critically important for migratory bull trout because these individuals are especially dependent on the thermal refugia maintained by these exchanges (Frissell 1999).

Hydrologists have long known that surface water and groundwater interact along river systems and research over the last two decades by ecologists and hydrologists has uncovered the functional importance of the hyporheic zone to the physical, chemical, and biological integrity of fluvial ecosystems (Boulton *et al.* 1998). Traditionally, water along river systems has either been defined as surface water or groundwater. However, other bodies or zones of water have recently been defined that are ecotones or intermediate in nature (physically, chemically and biologically) to surface and groundwater. The *hyporheic zone* is a broad term that defines the "saturated interstitial areas beneath the stream bed and into stream banks that contain some proportion of channel water or that have been altered by channel water infiltration (advection)" (White 1993).

The dimensions of the hyporheic zone can vary dramatically depending on the stream size, stream discharge, alluvial porosity and volume, and vertical and lateral exchange rates. In small headwater streams, the hyporheic zone is typically on the order of several meters both vertically and horizontally or entirely absent due to lack of alluvium or significant exchanges of water (streams dominated by uni-directional groundwater input) (White 1993). In large montane and lowland alluvial valleys, the hyporheic zone typically is on the scale of several meters below the streambed and on the order of 100-meters wide. In some highly conductive stream systems (e.g. Flathead River, MT, Yakima River, WA, Methow River, WA), the hyporheic zone can extend over 10 meters deep into alluvium and on the order of 3 km wide across the floodplain (Stanford *et al.* 1994, Stanford and Ward 1988, Stanford and Ward 1993).

In one of the few studies directly addressing the impacts of land use on hyporheic function and ecology, Boulton *et al.* (1997) compared the hyporheic ecology of five small streams in New Zealand under different land uses, such as native forest, exotic pine forest, and pasture. Many distinct abiotic and biotic differences were observed between the different sites. As expected, the temperatures of hyporheic water at the pasture site were significantly higher than either of the two forested sites. This was attributed to the lack of riparian shading and warmer stream temperatures. Warm water temperatures further reduce the levels of dissolved oxygen in the sediments (Poole and Berman 2001), which can be a critical control on the presence or absence of certain hyporheic taxa. Boulton *et al.* (1997) predict that as stream and hyporheic temperatures warm up due to a lack of riparian shading, the hyporheos community structure can dramatically shift towards a community dominated by a few taxa tolerant of low oxygen (hypoxia) and high temperatures.

Boulton *et al.* (1997) also notes the effects of a lack of a riparian canopy on other physical and ecological processes. They found that the forms of particulate organic matter entering the hyporheic zone differed between sites. Native forests contributed diverse types of leaf materials and woody debris to the hyporheic zone while pasture lands only contributed a few species of grass that decomposed rapidly and contributed little to aquatic production. Boulton *et al.* (1997) found that pasture streams supported significantly less *hyporheos* diversity than the native forest. They largely attributed this to high levels of interstitial fine sediment and the reduction of downwelling oxygen-rich surface water which both promote hypoxic conditions intolerable to some organisms. Although bull trout of the size expected to use the East Fork Lewis River are not known to feed on organisms associated with hyporheic zone, the complex biochemical processes that occur in the hyporheic zone can result in localized inputs of nutrients from the hyporheos to the stream that are then, in turn, used for algae production that subsequently supports invertebrates and forage fish production.

For the purpose of the HCP, a ground water and hyporheic flow analysis was conducted based on data from pre-existing water supply and data collected from 3 piezometers installed in December 1998 and monitored until July 2001 (Sweet *et al.* 2003). Groundwater contour maps (HCP Figures 3-11 and 3-12) were generated from these well measurements, made en masse several times during the study. Hydraulic conductivity was estimated from the literature, and assumed to be uniform across the analysis area. In addition, a key assumption was that "the water table surface in the alluvial sediments generally reflects surface topography" (HCP, pg. 3-25). This suite of field data and the accompanying assumptions complies with generally accepted engineering practice for water-supply groundwater investigations.

However, a key issue of concern has been hyporheic flow and ecology, and the potential existence of preferential pathways and emergence locations for hyporheic flow, groundwater, and mixtures of the two. In river floodplain sediments, preferential flow pathways abound, due to presence of buried paleochannel deposits. Studies of hyporheic flow find complex patterns even in terrain of relatively uniform surface appearance. These patterns include reaches where dominant flow is from river to floodplain, and seasonal shifts in subsurface water flow direction.

Groundwater gradients, as observed by the network of wells, were small, on the order of 0.003-0.008 ft/ft (HCP, pg. 3-26). In addition, hydraulic conductivities reported in the literature for the shallow alluvial aquifer range over many orders of magnitude (from 0.03 to 70,000 ft/day, with interquartile range form 50 to 900 feet per day, as described by McFarland and Morgan 1996). This would imply that variations in hydraulic conductivity could exert large influences on small-scale flow patterns that would not be detectable from water table elevation information alone.

The literature on field investigation of hyporheic flow reveals that piezometer networks with spacing on the order of a channel width or less are required to investigate these systems (e.g. Huggenberger *et al.* 1998, Kasahara and Wondzell 2003). Tracer studies are often used to supplement water level observations, and paired piezometers to measure vertical gradients are often employed. Rather than assume that water table gradients are uniform and reflect surface topography, preferential flow is anticipated to follow relic channels indicated by subtle soil and topographic features (Paul Bakke, Service Hydrologist/Geomorphologist, pers. comm. 2004). In short, the spatial resolution of groundwater investigations presented in the HCP is too coarse for characterization of preferential flow, including floodplain hyporheic flow and localized groundwater emergence.

The implications of this difference in spatial resolution are that undetected preferential flow pathways could exist in the vicinity of the proposed expansion, that hyporheic flow could extend further from the current channel than predicted on Figures 3-11 and 3-12, and that localized areas of groundwater/hyporheic water emergence in the river channel could also go undetected.

However, the degree to which the existing Daybreak Mine pits and the avulsion-induced channel instability have already disrupted preferential subsurface water flow pathways and emergence locations is expected to be high. Subsurface flow is already refracted around the existing ponds, as well as intercepted by these ponds and converted to surface flow or evaporated. It is possible that ongoing rapid channel evolution could render the type of detailed information on preferential flow discussed above limited in usefulness, even if it were available.

The existing Daybreak Mine ponds are and would remain connected to groundwater and hyporheic flow. Investigations conducted prior to and during HCP development, characterized the extent of hyporheic flow as limited to the existing ponds, but the potential for some fraction of hyporheic flow to flow through the proposed expansion area cannot be ruled out. The general direction of groundwater and hyporheic flow through the Daybreak Mine site generally parallels the direction of flow in the East Fork Lewis River.

Although some warmer water from the ponds can be expected to be incorporated into the groundwater and hyporheic water and eventually flow via the alluvium to the East Fork Lewis River, temperatures are expected to moderate as water flows through the alluvial aquifer. This moderation is expected to occur because of the amount of time it would take for pond water to travel via the alluvium to the East Fork Lewis River (which could be 70 to 200 days) (Sweet *et al.* 2003), and the fact that as subsurface water infiltrates the ground and moves downward and towards the streambed, water temperatures tend to equilibrate with the temperature of the subsurface soil layers (Beschta *et al.* 1995). As an example, continuous recorders placed at two locations between the existing ponds and the East Fork Lewis River from November 2000 to December 2001 recorded groundwater temperatures during late summer period that were as much as 9° to 11°C lower than water temperatures recorded in the East Fork Lewis River or the ponds during the same time period.

The effects of advection, or the mixing of stream flow with the flow from groundwater and tributary streams, depend on the relative inputs of these sources to stream discharge. In the East Fork Lewis River, average groundwater inflow rates at RM 10.6 (upstream of the Daybreak Mine site) and 6.5 (downstream of the Daybreak Mine site) were 0.58 and 1.59 cfs, respectively for data obtained in October 1987 (McFarland and Morgan 1996). Mean monthly discharge of the East Fork Lewis River for the month of October is 449 cfs (Hutton 1995). This represents a contribution of groundwater inputs from the Daybreak Mine site to the East Fork Lewis River of significantly less than 1 percent of the total flow of the river. Even if the new ponds captured a significant portion of this groundwater or hyporheic flow, groundwater resources from the Daybreak Mine site are likely to have little negative or positive effect on either the volume of flow in or the overall temperature of the East Fork Lewis River. Not withstanding, opportunistic, foraging bull trout are not expected to enter the East Fork Lewis when flows are at their summer lows and temperatures are unsuitable.

Upon implementation of the HCP and approval for a change in water rights by Ecology, Storedahl would donate 237 afy of their water rights to the State Trust for the enhancement of instream flow in both the East Fork Lewis River and Dean Creek. At the completion of gravel mining and processing, the remaining water rights would be donated for instream flow purposes for a total of 330 afy. Groundwater from the site has been historically pumped and used on 165 acres of agricultural lands at the Daybreak Mine site. Irrigation of agricultural crops or pasture regularly occurs during the driest months of the year (May-September), a time also when stream flows are typically at their lowest levels and stream temperatures are at their highest levels. During May through September, mean monthly discharge of the East Fork Lewis River at the Daybreak Mine site can fall below the mean annual discharge of 1000 cfs and decline to as low as 108 cfs in August (Hutton 1995). Under the HCP, the majority of groundwater (72 percent of the water right) that would normally be pumped for irrigation purposes from May to September would remain as groundwater. The remaining 28 percent would be used to process gravel and to irrigate plantings, and later donated to the State Trust when processing operations are completed (projected to be 15 years) or the term of the HCP expires (25-year term), whichever comes first. This measure would result in the donation in perpetuity of 330 afy of groundwater rights or the equivalent of approximately 1.1 cfs if averaged over the irrigation season. This amount of groundwater flow would have a small but positive effect on base flows and water temperatures in the East Fork Lewis River, in turn, indirectly improving, if only slightly, conditions for foraging bull trout that may utilize the East Fork Lewis River. Again, opportunistic, foraging bull trout are not expected to enter the East Fork Lewis when flows are at their summer lows and water temperatures are unsuitable (above 16°C).

Coastal Cutthroat Trout

Freshwater and anadromous coastal cutthroat trout are present in the East Fork Lewis River, although their abundance is depressed from the historical population size (WDFW 2000). Sea-run coastal cutthroats generally remain close to shore while in the ocean and return to freshwater in summer, fall, or winter of the year they go to sea (Trotter 1997). They over-winter in freshwater and spawn in the spring. Cutthroat trout spawn in clean gravels in low gradient reaches of small streams. Resident, upstream migrating, and over-wintering coastal cutthroat trout are likely to be present in the East Fork Lewis River and Dean Creek. When conditions are favorable, some coastal cutthroat trout may spawn and their progeny may rear in Dean Creek. Coastal cutthroat trout are not expected to spawn in the East Fork Lewis River in the immediate vicinity of the Daybreak Mine, as they prefer to spawn in low gradient reaches of small tributaries, or in the lower regions of streams (Trotter 1997). This habitat does not exist in the East Fork Lewis River adjacent to the Daybreak Mine site.

Minimization and Mitigation Measures Benefiting Coastal Cutthroat Trout

Several conservation measures committed to in the final HCP, directly or indirectly, minimize and mitigate anticipated impacts of covered activities to coastal cutthroat trout. CM-01 commits Storedahl to the installation and operation of a closed-loop wash water clarification system by year three of HCP implementation. The purposes of the closed-loop system are to 1) substantially reduce or eliminate discharges of turbid process water and effectively eliminate the discharge of process water to receiving waters (existing ponds) and Dean Creek, and 2) precipitate dissolved phosphorous and increase the transparency of the pond water. This should result in a decrease in algal growth, subsequently decreasing the decomposition of organic matter and increase DO levels in the ponds. The closed-loop system would remove solids from the process water and re-circulate the process water back to the aggregate processing system. Solids removed from the closed-loop system would be run through a belt press, or similar system, to further reduce moisture content. Solids would be stored on the Daybreak Mine site to dry further and then eventually be incorporated into reclamation actions. Process water from the belt press would be re-circulated back to the aggregate processing system for reuse. All water used to wash the gravel would be recycled reducing the demand for water. Relatively small amounts of water would be needed to occasionally recharge the closed-loop system. The closed-loop system would also substantially reduce or eliminate the need to discharge water into the existing ponds as previously required during washing operations. This, in turn, would greatly reduce the amount of suspended sediment and high levels of turbidity in the ponds that were common under the previous washing operations. Implementation of CM-01 indirectly benefits coastal cutthroat trout by improving the quality of water on site and the quality of the water subsequently discharged to Dean Creek and the East Fork Lewis River.

CM-02 commits Storedahl to implement a comprehensive storm water/surface water and erosion control plan as well as a storm water pollution prevention plan to minimize adverse impacts to water quality as a result of mining and reclamation activities. This CM is designed to manage storm water and surface water runoff and potential sources of water contamination on site, before these potential sources of turbidity, suspended sediments, and pollutants can enter Dean Creek or the East Fork Lewis River and negatively affect water quality. This measure includes 1) isolating impacts to surface water from mining and reclamation activities; 2) containing and pre-treating surface runoff; 3) re-vegetating bare soils; 4) preventing and managing oil and fuel spills; 5) installing a conveyor to transport mined aggregate; 6) maintaining surfaces on active roads; 7) having a water truck and street sweeper on site, as needed; 8) decommissioning unused haul roads; and 9) specifying in advance conditions that would result in a suspension of operations due to water quality concerns. Implementation of CM-02 would indirectly benefit coastal cutthroat trout by improving water quality of on-site water and water discharged to Dean Creek and, subsequently, the East Fork Lewis River.

Storedahl would immediately donate 237 afy of water rights on the property to the State Trust for the enhancement of instream flows in the East Fork Lewis River and Dean Creek (CM-03). All water rights associated with the property (330 afy) would be donated to the State Trust, in perpetuity, for instream flow enhancement at the completion of processing operations or the term of the ITP, whichever comes first. Flows in the East Fork Lewis River vary seasonally, with the lowest usually occurring during the summer months prior to the onset of fall rains. Donating water rights to the State Trust for the enhancement of instream flows would directly benefit coastal cutthroat trout by improving base flow conditions for Dean Creek and lower East Fork Lewis River during critical low flow periods.

CM-04 is intended to manage the discharge of pond water to provide seasonal benefits to Dean Creek and to prevent Dean Creek from entering Pond 5 during periods of high flows. By managing the release of pond water and preventing Dean Creek from over flowing into Pond 5 during most high flow events (floods less than a 17-year return period), water quality including, water temperatures, will be improved.

Under CM-05, Stordahl will establish a conservation and habitat enhancement endowment up to 1 million dollars plus earnings for the monitoring, habitat enhancement, and management of the 300-acre property after the completion of all site reclamation activities. In association with the endowment, Storedahl will grant a perpetual conservation easement on the entire property and convey the property in fee title to one or more conservation-minded groups. These commitments will ensure that reclamation measures implemented under the HCP will be maintained and managed in perpetuity for the benefit of all covered species.

Under CM-06, Storedahl would establish native forest on unforested areas within the 100-year floodplain (FEMA 2000), along existing and created ponds, and on upland areas. Initial plantings would occur immediately upon issuance of an ITP and other necessary permits, and the remaining plantings would be part of the reclamation activities. In total, 136 acres would be planted to trees providing a future source of shade, soil stability, detrital inputs, and large and coarse woody debris. Implementation of CM-06 would indirectly benefit coastal cutthroat trout by enhancing riparian conditions adjacent to the East Fork Lewis River and Dean Creek.

CM-07, CM-13, and CM-14 would enhance habitat associated with Dean Creek. Dean Creek is currently confined by the J.A. Moore Road bridge and discontinuous levees running along its banks downstream of J.A. Moore Road. An active dairy farm on the west and north bank of Dean Creek has degraded habitat by denuding stream banks and increasing the nutrient load of the stream. Under high flow conditions, Dean Creek can flow into Pond 5 causing pond water to mix with Dean Creek resulting in increased turbidity in Dean Creek downstream of Pond 5. In concert with CM-04, Storedahl will implement CM-07 to reestablish the floodplain along the eastern bank of Dean Creek through regrading and contouring to create a series of low terraces to provide overbank functions and prevent Dean Creek from entering Pond 5. This would prevent coastal cutthroat trout that reside in Dean Creek from entering Pond 5, prevent predatory fish from escaping Pond 5, and prevent the intermixing of Dean Creek and Pond 5 that has resulted previously in the release of sediment from Pond 5 into Dean Creek and subsequently the East Fork Lewis River. Under CM-13, terraces would be planted with native riparian species to enhance soil stability and flow resistance during higher flows, and a 200-foot riparian management zone would be established adjacent to the Dean Creek along the east bank. This work would be completed during the first five years upon issuance of the ITP.

Following the reestablishment of floodplain terraces on the east bank under CM-07, LWD would be added to Dean Creek at a frequency of greater than one piece per 72 feet of channel length. In-channel structures would consist of key pieces of conifer logs that are at least 88 cubic feet in volume. The purpose of CM-14 is to increase habitat complexity in Dean Creek. Cutthroat trout have been observed in Dean Creek, but current habitat conditions probably prevent the establishment of a self-sustaining population of coastal cutthroat trout. CMs designed to improve habitat conditions in Dean Creek would directly benefit coastal cutthroat trout with the goal of reestablishing a self-sustaining run of coastal cutthroat trout in Dean Creek. Work necessary to complete CM-14 would be conducted in the summer when flows in Dean Creek are subsurface.

Under CM-08 and 09, Storedahl would incorporate mining and reclamation designs that reduce the risk of an avulsion into the existing ponds and expanded mine area and that would minimize the effects and recovery time if an avulsion were to occur. All expanded mining would be outside the 100-year floodplain (FEMA 2000), approximately 86 percent of the excavated area would be outside of historic channel locations, as defined by 150 years of observations (Collins 1997), and/or separated from the East Fork Lewis River by established and regularly maintained roads. The existing ponds would be reclaimed so that there is a wider, vegetated buffer between these ponds and the East Fork Lewis River and the existing ponds would be narrowed and shallowed to reduce geomorphic recovery should an avulsion occur in the future. Storedahl Pit Road will also be upgraded to protect against an avulsion entering Pond 1. Implementation of CM-08 and 09 would indirectly benefit coastal cutthroat trout by minimizing the potential for and the effects of an avulsion on fish habitat in the East Fork Lewis River.

Under CM-11, Storedahl would provide labor, equipment, and/or materials in cooperation with public or non-profit groups to enhance East Fork Lewis River floodplain functions and fish habitat related to the protection and recovery of covered species. Although these services may not be specifically directed at improving coastal cutthroat trout habitat, enhancement efforts in the lower reaches of the East Fork Lewis River would directly benefit coastal cutthroat trout in the East Fork Lewis River by improving habitat in and adjacent to the East Fork Lewis River and/or its tributaries.

CM-16 would indirectly benefit coastal cutthroat trout by committing Storedahl to proactive measures to eliminate or control the number of non-native predatory fish by removing fish that reside in the existing ponds and by placing educational signs informing the public about the dangers of releasing non-native fish into ponds adjacent to streams, rivers, and wetlands. Non-native predatory fish that are allowed to live and mature in the existing or new ponds pose a potential threat to juvenile cutthroat trout as well as compete for prey with adult cutthroat trout. These fish, including large mouth bass, have either entered these ponds during flooded conditions or were intentionally introduced for the purposes of fishing. Regardless of their origin, these predatory fish pose a threat to salmonids if allowed to proliferate unchecked in the existing ponds or if purposefully stocked into the new ponds.

Non-native fish are known to occur in Pond 5 and it is probable that they also occur in some, if not all, of the remaining four ponds. As part of CM-16, targeted harvest of non-native predatory fish in the existing ponds would occur in years 5, 10, and 15 to reduce their numbers. Rock barriers between ponds would also be constructed and maintained to prevent these fish from moving between ponds. In an attempt to inform fishermen of the negative consequences of introducing non-native predatory fish to the existing ponds or the new ponds, educational signs will be erected. Signs would be placed in plain view and would warn the public about the dangers to native fishes of introducing non-native fish to the ponds. CM-08 would also indirectly affect the numbers of non-native predatory fish by narrowing, reshaping, and shallowing the existing ponds. Although this measure was designed to address an avulsion, it also would eliminate much of the deep, open water habitat currently utilized by non-native predatory fish.

Effects of Sediment on Coastal Cutthroat Trout

Gravel mining would be conducted on 101 acres of agricultural lands above the 100-year floodplain (FEMA 2000). The excavation of commercially desirable gravel requires the removal of overburden including topsoil and culled aggregate material that is not suitable for processing. These materials would be separated and temporarily stored on site and used in the reclamation of the site. Reclaimed areas will be revegetated using native species per CM-06 and CM-07 and non-native, evasive species will be controlled per CM-06, CM-07, and Appendix B of the HCP. Once the overburden is removed, gravels and associated fines would be mined with a trackhoe or dragline and transported by conveyor or truck to the processing area. The sources of gravel identified at the Daybreak Mine site contain very low amounts of fine sediments (roughly 2 percent). A total of approximately 400,000 cubic yards or 1 million tons of gravel would be mined per year resulting in approximately 8,000 cubic yards or 20,000 tons of fines per year. Fines would also be generated when gravels from off-site sources are transported to the Daybreak Mine site to be processed. Storedahl has historically imported 300,000 cubic yards per year of pre-screened material to the Daybreak Mine site for processing. This pre-screened material includes approximately 4 percent fines. Assuming on-site aggregate and imported off-site materials are processed at the site, the amount of fines projected to be generated annually from this activity would be approximately 20,000 cubic yards (30,000 tons). Fines generated by gravel processing and topsoil and overburden excavate during mining will be used for reclamation activities. Up to an additional 300,000 cubic yards of clean fill will be transported from off-site locations to the Daybreak Mine site to be used in the reclamation of the existing ponds per CM-08.

The fines from the above mentioned sources, when allowed to enter the Dean Creek or East Fork Lewis River, could negatively impact habitat below the Daybreak Mine site, in turn, adversely affecting any foraging coastal cutthroat trout in the East Fork Lewis River below the Daybreak Mine site directly and through impacts to prey, as described below. Gravel processing during the first 3 years will result in process water being discharged into Pond 1 and the existing ponds will be used for settling. In addition, during active mining operations the existing ponds will be used to treat surface water runoff during storm events.

The overall effects of sediment on fish can be put into three classes (Newcombe and MacDonald 1991; Bash *et al.* 2001): 1) lethal effects which result in the direct death of individual fish, cause population reductions, or damage the capacity of the ecosystem to produce fish; 2) sublethal effects which result in injury of the tissues or physiology of the fish and while not leading to immediate death, may produce mortalities and population decline over time; or 3) behavioral effects which change the activity patterns or alter the kinds of activity usually associated with an unperturbed environment. Behavioral effects may lead to immediate death or population decline or mortality over time.

Specific effects of sediment on fish and their habitat include (Newcombe and MacDonald 1991; Waters 1995; Bash *et al.* 2001) the following:

Lethal:	Direct mortality to any life stage, reduction in egg-to-fry survival, or loss of spawning or rearing habitat.
Sublethal:	Reduction in feeding and growth rates, decrease in habitat quality, reduced tolerance to disease and toxicants, respiratory impairment, and physiological stress.
Behavioral:	Avoidance and distribution, homing and migration, and foraging and predation.

Coastal Cutthroat Trout and Prey: Coastal cutthroat trout prey on a variety of species including terrestrial and aquatic insects and fish (Trotter 1997). The three main families of insects that cutthroat trout are known to utilize as prey include Ephemeroptera (mayflies), Tricoptera (caddisflies), and Plecoptera (stoneflies). Fish including juvenile salmonids are also common in the diet of coastal cutthroat trout. Therefore, increased sediment inputs into the East Fork Lewis River and Dean Creek may not only affect the ability of coastal cutthroat trout to forage effectively and efficiently, but sediments may also impair the spawning and/or reduce the availability of prey species such as juvenile salmonids and aquatic insects.

Turbidity and suspended solids can affect macro-invertebrates in multiple ways: increased invertebrate drift, feeding impacts, and loss of habitat. The effect of light reduction from turbidity has been well documented and results in increased invertebrate drift (Waters 1995). This may be a behavioral response associated with the night-active diel drift patterns of macro-invertebrates. While increased turbidity results in increased macroinvertebrate drift, it is thought that the overall invertebrate populations would not fall below the point of severe depletion (Waters 1995).

Increased suspended sediment can affect macro-invertebrates by abrasion of respiratory surface and interference of food uptake for filter-feeders (Birtwell 1999). Increased suspended sediment levels tend to clog feeding structures and reduce feeding efficiencies that result in reduced growth rates, increased stress, or death of the invertebrates (Newcombe and MacDonald 1991).

Invertebrates living in the substrate are subject to scouring or abrasion, which can damage respiratory organs of aquatic insects (Bash *et al.* 2001).

Benthic invertebrates inhabit the stream bottom. Therefore, any modification of the streambed by deposited sediment will most likely have a profound effect upon the benthic invertebrate community (Waters 1995). Increased sediment can affect macroinvertebrate habitat by filling of interstitial space. The degree to which substrate particles are surrounded by fine material was found to have a strong correlation with macroinvertebrate abundance and composition (Birtwell 1999). At an embeddedness of one-third, insect abundance can decline by about 50 percent, especially for riffle-inhabiting taxa (Waters 1995). A decrease in aquatic benthic invertebrates could directly and indirectly affect the ability of coastal cutthroat trout to forage by decreasing the food base of coastal cutthroat trout and the food base of their prey.

The physical implications of sediment in streams include degradation of spawning and rearing habitat, damage to habitat structure, and loss of habitat. Biological implications of this habitat damage include underutilization of stream habitat, abandonment of traditional spawning habitat, displacement of fish from their habitat, and avoidance of habitat (Newcombe and Jensen 1996). As sediment enters a stream it is transported downstream under normal fluvial processes and deposited in areas of low shear stress (MacDonald and Ritland 1989). These areas are usually behind obstructions, near banks (shallow water) or within interstitial spaces. This episodic filling of successive storage compartments continues in a cascading fashion downstream until the flow drops below the threshold required for movement or all pools have reached their storage capacities (MacDonald and Ritland 1989). As sediment load increases, the stream compensates by geomorphologic changes in increased slope, increased channel width, decreased depths, and decreased flows (Castro and Reckendorf 1995). These processes also contribute to increased erosion and sediment deposition, which further degrade salmonid habitat.

The addition of fine sediment (less than 6.4 mm) to natural streams during summer decreased abundance of juvenile Chinook salmon in almost direct proportion to the amount of pool volume lost to fine sediment (Bjornn *et al.* 1977). Similarly, the inverse relationship between fine sediment and densities of rearing Chinook salmon indicates the importance of winter habitat and high sediment loads (Bjornn *et al.* 1977). As fine sediments fill the interstitial spaces between the cobble substrate, juvenile Chinook salmon, in the Red River in Idaho, were forced to leave preferred habitat and to utilize cover that may be more susceptible to ice scouring, predation, and decreased food availability (Hillman *et al.* 1987). Deposition of sediment in substrate may also lower winter carrying capacity for bull trout (Shepard *et al.* 1984). Food production in the form of aquatic invertebrates may also be reduced. Increased sediment inputs to either Dean Creek or the East Fork Lewis River could directly reduce the number of juvenile coastal cutthroat trout and/or negatively affect the amount of prey available to foraging coastal cutthroat trout.

Increased suspended sediment and turbidity can affect feeding, growth rates and, therefore, reproductive capability in two ways: decreased prey abundance and a decline in feeding efficiency. In streams, increased turbidity results in decreased light penetration into the water column (Lloyd *et al.* 1987). This results in decreased photosynthesis and, therefore, reduces primary production (Waters 1995). Macroinvertebrate populations (secondary production) depend upon primary production for food, especially in fourth to sixth order streams (Vannote *et al.* 1980). Decreased photosynthesis and primary production, as well as the direct impact from sedimentation, can decrease macro-invertebrates abundance.

Feeding Efficiency: Increased turbidity and suspended sediment can affect a number of factors related to feeding for salmonids, including feeding rates, reaction distance, and prey selection (Bash *et al.* 2001). Changes in feeding behavior are primarily related to the reduction in visibility that occurs in turbid water. Effects on feeding ability are important as salmonids must meet energy demands to compete with other fish for resources and to avoid predators.

Distance of prey capture and prey capture success both were found to decrease significantly when turbidity was increased (Berg and Northcote 1985). Waters (1995) asserts that loss of visual capability, leading to reduced feeding is one of the major sublethal effects of high suspended sediment concentrations. Loss of visual capability leads to depressed growth and reproductive capability.

Sigler *et al.* (1984) found that a reduction in growth occurred in steelhead and coho salmon when turbidity was as little as 25 NTUs. However, this could have resulted from more than just a reduced ability to catch prey once detected, for example it could have been from an inability to see prey (insufficient light, also an impact from increased turbidity). Redding *et al.* (1987) found that suspended sediment may inhibit normal feeding activity, which resulted from loss of visual ability or as an indirect consequence of increased stress.

High levels of suspended sediment and turbidity can result in direct mortality of fish by damaging and clogging gills, smothering eggs or alevins, or decreasing fry emergence rates. Concentrations of suspended sediment as low as 25 milligrams/liter (mg/l) for 24 hours resulted in 5.7 percent mortality in sac fry of Arctic grayling (Newcombe and MacDonald 1991). Suspended sediment concentrations of 500 to 6,000 mg/l have been reported to be either fatal or lowered fish survival (Lloyd *et al.*1987). Sigler *et al.* (1984) reported mortality of coho salmon and steelhead fry at 500 to 1500 mg/l. These laboratory results may be underestimating mortality rates if the equivalent elevated level of sediment was found in natural streams. The conditions in the laboratory do not replicate conditions in the wild with respect to sediment type, water velocity, and potential abrasive and scouring effects, fluctuation in dissolved gases, and feeding and food supplies (Birtwell 1999).

Lethal Effects: The effect of suspended sediment, deposited in the redd and potentially reducing water flow and smothering eggs or alevins and impeding fry emergence, is related to sediment particle sizes (Bjornn and Reiser 1991). Sediment particle sizes determines the pore openings in the redd gravel. With small pore openings, more suspended sediments are deposited and water flow is reduced compared to large pore openings. Low dissolved oxygen and reduced water exchange increase embryo mortality (Chapman 1988).

Fine sediment in spawning gravels has been found to increase embryo mortality by 50 percent for cutthroat trout, 25 percent for rainbow trout, and 10-20 percent for kokanee and steelhead (Bjornn and Reiser 1991). In addition, the percentage of fry emerging from spawning gravels decreases approximately 40 percent with 20 percent fines (< 6.4 millimeters (mm)) in the spawning gravel (Bjornn and Reiser 1991).

Physiological and Behavioral (Sublethal) Effects: Sublethal levels of suspended sediment may cause undue physiological stress on fish, which may reduce the ability of the fish to perform vital physiological and behavioral functions. Although such stress may not be severe, it may reduce the ability of the fish to feed or resist exposure to disease and toxicants (Waters 1995). Redding *et al.* (1987) observed higher mortality in young steelhead trout exposed to a combination of suspended sediment (2.5 g/L) and a bacteria pathogen, than when exposed to the bacteria alone. Physiological stress in fishes may decrease immunological competence, growth, and reproductive success (Bash *et al.* 2001).

Increased turbidity and suspended sediment may result in behavior changes in salmonids. This includes avoidance, distribution, homing, and migration. Although an avoidance response may be an initial adaptive survival strategy, displacement could be detrimental. It is possible that the consequences of fish moving from preferred habitat to avoid increasing levels of suspended sediment may not be beneficial if displacement is to sub-optimal habitat, or if they become stressed and more vulnerable to predation.

Increased sediment loading into the East Fork Lewis River that occurs as a result of gravel mine expansion could negatively affect coastal cutthroat trout due to impacts to foraging behavior, habitat degradation, food supply disturbances, and decreased water quality. Although these effects could be serious and would depend on the magnitude and duration of any sediment loading event, the effects of sediment generated by gravel mining activities on coastal cutthroat trout would be minimized by the CM described previously. Commitments under the final HCP are designed to manage sediment and gravel mining activities that generate sediment on site, preventing sediment that would otherwise be harmful to coastal cutthroat trout from entering the East Fork Lewis River and Dean Creek. During the first three years, the wet-processing of gravel will be used in combination with flocculants and coagulants to reduce turbidity in the ponds and subsequently Dean Creek. After year three, the closed-loop clarification system will be used to continue to reduce turbidity without the need to discharge process water to the ponds.

The closed-loop system is designed to remove sediments from gravel without the need to discharge sediment laden or turbid water into the existing ponds. The final design of the closed-loop system will be developed in consultation with the Services, and Ecology to ensure the intended results are achieved. The closed-loop system will effectively eliminate process water discharge to the ponds, but the ponds will continue to be used to settle out sediments derived from storm water and surface water runoff. Prior to the installation of the closed-loop system, gravel will be wet-processed via the method developed and tested on site from May of 1999 through June 2001. This system used flocculants and coagulants in conjunction with the settling ponds to remove sediments from the wash water. Turbidity levels were tested regularly at the outlet to Dean Creek. NTU levels measured and recorded during this time period where at least one half the currently permitted level of 50 NTUs and were typically less that one-fifth of the currently permitted level or 10 NTUs (Sweet *et al.* 2003). Turbidity will be measured weekly per the NPDES permit at the point where Pond 3 over flows into Pond 5. The HCP specifies that turbidity at this point is not to exceed 25 NTUs. Although 25 NTUs will be the permitted level under the HCP, further reductions in turbidity are expected to occur from settling action in Pond 5 before water is discharged to Dean Creek. Discharges to Dean Creek during active gravel mining and processing are expected to occur on a daily basis during October through June.

A SWPPP/ESC would be implemented to reduce sediments generated from storm water and surface water run-off events. Surface runoff from mining and reclamation activities are potential sources of suspended sediments and are in addition to sediments generated from gravel processing. Although sediments generated during gravel processing will be minimized via the closed-loop clarification system, sediment generated during storm water runoff will not be processed in this manner. Instead, the SWPPP/ESC (Sweet *et al.* Appendix D 2003) is designed to prevent sediment caused from storm water runoff from entering Dean Creek or the East Fork Lewis River. Approaches summarized in CM-02 and further described in the SWPPP/ESC include minimizing the area susceptible to erosion, isolating active work areas, conducting mining and reclamation activities during May through September when surface water is typically not discharged to Dean Creek via Pond 5 outlet, using created ponds for settling and detention, and using conveyors to transport materials to reduce erosion and dust due to traffic on haul roads. The SWPPP/ESC also calls for the use of BMPs including seeding of exposed soils, road maintenance, and the use of silt fences, straw bales, ditches, sediment ponds, and rock barriers to divert runoff from exposed soils.

Installation of the closed-loop system and the implementation of the SWPPP/ESC are expected to achieve similar or better results with increased levels of water quality monitoring and toxicity testing without the need to discharge process water directly to the ponds. Effectiveness and toxicity will be monitored per MEM 01, 02, and 03 to ensure turbidity levels are being achieved and chemicals chosen are not toxic to covered species (See Effects of Inorganic Flocculants, Coagulants, and Polymers on Covered Species).

Exposure of coastal cutthroat trout to excess sediment in Dean Creek will occur 8 to 10 hours a day, 5 days a week, from October through June each year during gravel processing operations (the first 10 to 15 years). It is expected that coastal cutthroat trout will move out of the area to avoid sediment plumes, and that their use of the area will be precluded until high sediment levels have subsided. The FWS conservatively estimates that turbidity levels which would result in lethal, sublethal, and behavioral effects to juvenile, subadult, and adult coastal cutthroat trout are reasonably certain to occur in Dean Creek below the Pond 5 outlet to its confluence with the East Fork Lewis River, a distance of approximately 1700 feet. Dean Creek currently provides only limited, low quality coastal cutthroat trout spawning and rearing habitats and, therefore, the anticipated effects from sediments as a result of day-to-day gravel mining and processing are likely to have only negligible impacts on coastal cutthroat populations in the East Fork Lewis River.

Turbidity from day-to-day gravel mining, processing, and reclamation activities that would result in adverse effects to coastal cutthroat tout are not anticipated to reach the East Fork Lewis River because sediment from the ponds is expected to settle out prior to reaching the East Fork Lewis River.

Sediments derived from the closed-loop system will be temporarily stockpiled above the 100-year floodplain (FEMA 2000) until they can be utilized for site reclamation activities. All reclaimed materials will be vegetated to minimize the erosion of placed sediments. Sediments generated during gravel mining, gravel processing, and reclamation activities are more likely to enter the East Fork Lewis River during an avulsion event. The effects of an avulsion are discussed later in this section.

Effects of Temperature on Coastal Cutthroat Trout

Because most aquatic organisms including salmonids are ectothermic (cold-blooded), water temperature plays an important role in regulating biological and ecological process in aquatic systems. Temperature directly and indirectly affects physiology, development, and behavior of salmonids, as well as mediates competitive interactions, predator-prey relationships, and the incidence of parasitism and disease (Spence *et al.* 1996). Water temperatures significantly affect the distribution, health, and survival of native salmonids in the Pacific Northwest. Their survival is dependent on external water temperatures and they will experience adverse health effects when exposed to temperatures outside their optimal range (USEPA 2003). Almost all biological and ecological processes that affect salmonids are affected by ambient water temperatures (Spence *et al.* 1996). Adverse temperatures can affect growth, behavior, disease resistance, competition, and mortality (Sullivan *et al.* 2000).

Most of the literature on salmonid temperature requirements refers to "preferred", "optimal", or "tolerable" temperatures or temperature ranges (Everest *et al.* 1985; Bell 1986; Bjornn and Reiser 1991). "Preferred" is used to describe the temperature to which, given unlimited acclimation time, a fish will ultimately gravitate towards (Fry 1947 in Spence *et al.* 1996). "Optimal" temperature range means the temperatures at which fish can best perform specific activities. The "tolerable temperature" range includes temperatures at which fish can survive indefinitely (Spence *et al.* 1996).

Coastal cutthroat trout are exposed to a wider range of water temperatures across their distribution relative to other salmonids but in comparison little information on their habitat requirements is available (Hunter 1973; Golden 1975; Bjornn and Reiser 1991). Still, like other salmonids, coastal cutthroat trout have evolved to take advantage of temperatures regimes in their home ranges (Johnson *et al.* 1999). When abrupt changes occur in water temperatures or other physical factors, the fish usually compensate by seeking refugia but changes from the normal pattern can reduce their survival (Golden 1975; Bjornn and Reiser 1991). In several studies (Hunter 1973; Behnke and Zarn 1976; Behnke 1992), cutthroat trout, like other salmonids, were not usually found in water temperatures higher than 22° C, although they could tolerate temperatures as high as 26° C for brief periods. Typically, adult fish appeared stressed when temperatures rose above 22° C. At 28° C to 29° C fish lost equilibrium and died, even when temperatures were gradually increased by 1-2° C per day (Behnke and Zarn 1976; Johnson *et al.* 1999). McCullough (1999) found that Chinook salmon and steelhead died at temperatures of 21-22° C in the Columbia River. McCullough (1999) also found that adult and subadult salmonids maybe less tolerant of high temperatures than juveniles of the same species.

Excessively high temperatures during migration may also cause outbreaks of disease (Spence *et al.* 1996).

Salmonids have been observed to spawn at temperatures ranging from 1-20° C (Bjornn and Reiser 1991) but most spawning occurs between 4° and 14° C (Spence *et al.* 1996). Optimum temperatures for spawning coastal cutthroat trout and egg incubation range from 6.1° C to 17.2° C and 4.4° C to 12.7° C, respectively (Bjornn and Reiser 1999; Johnson *et al.* 1999). Juvenile cutthroat trout preferred temperatures around 15° C (Johnson *et al.* 1999). Most adult salmonids typically migrate at temperatures less than 14° C and excessively high or low temperatures may result in delays in migration (Spence *et al.* 1996). Cutthroat trout may hold at the mouths of spawning streams until temperatures in the stream increase to the preferred temperature range (Bjornn and Reiser 1991). When water temperatures are excessively high, coldwater refugia may be important to salmon as they migrate upstream (Spence *et al.* 1996).

Land use practices, such as gravel mining and processing, can have a measurable effect on stream temperatures. Riparian vegetation modifies convective and evaporation heat-exchange losses by creating a microclimate of relatively high humidity, moderate temperatures, and low wind speed. The loss of riparian vegetation through gravel mining, should it occur in riparian areas, can result in an increase in temperatures, increase in wind speed, and a decrease in humidity resulting in the transfer of heat energy to the stream (Spence *et al.* 1996). Stream temperatures may also increase due to the inputs of heated water from off-channel ponds created by gravel excavation (OWRRI 1995). The East Fork Lewis River in the vicinity of the Daybreak Mine site is a naturally wide, low elevation alluvial channel making it particularly susceptible to temperature impacts (Sullivan *et al.* 1990). Ecology lists the East Fork Lewis River on its 303(d) list as water quality impaired due, in part, to elevated water temperatures (Ecology 2001). Summer water temperatures can exceed 22° C at the Daybreak Park, 2 miles upstream of the HCP area (Hutton 1995). Dean Creek can also reach similar or higher temperatures during summer low flow periods, and the flow in Dean Creek near the J.A. Moore Bridge can go subsurface during the same periods.

The majority of land surface proposed for mining under the HCP is agricultural and all the area is outside the 100-year floodplain (FEMA 2000) and, therefore, very few, if any, riparian trees would be removed. Instead, under the HCP, 24 acres of riparian forest and 8 acres of upland forest would be preserved. In the first year of the HCP, approximately 20 acres would be subject to a conservation easement perpetually protecting riparian and valley bottom forests. In addition, approximately 134 aces of mixed conifer and hardwood forest and riparian forest would be planted prior to and concurrent with mining and reclamation activities. Retention of existing forested areas, especially areas adjacent to or within the 100-year floodplain (FEMA 2000), would continue, albeit on a small scale, to modify convective and evaporation heat-exchange losses by creating a microclimate of relatively high humidity, moderate temperatures, and low wind speeds while providing a native seed source for future forests. The establishment of an additional 134 acres of forest over the term of the HCP would, over time, provide similar benefits and would have a net positive effect on surface and ground water temperatures.

However, 64 acres of new surface water would be created in the expanded mining area. This water would be exposed to the warming effects of direct sunlight and, during certain times of the year, could flow as surface water to Dean Creek and, subsequently, the East Fork Lewis River potentially increasing water temperatures of those water bodies. Implementation of CM-04 is intended to manage the discharge of Pond 5 to provide seasonal benefits to Dean Creek and prevent the release of warmer water during critical periods.

Surface-water discharge between and from the ponds will be controlled by site grading and pond construction. Surface outflow from Pond 5 will be restricted to a single location and controlled by the installation of a gravity-fed outlet structure at the northwest corner of Pond 5. This structure will be used to control pond levels and direct pond water discharge directly into Dean Creek during late fall, winter, and early spring when water temperatures in Pond 5 are within acceptable limits. Water temperatures in Pond 5 during this time period are typically 12° C or less. During warmer months (May through September), the gravity-fed outlet will be closed or is expected to be higher than pond surface water, and an average flow of 0.3 cfs will be pumped from the bottoms of stratified Ponds 3 and 5 into Dean Creek below J.A. Moore Road. Water temperatures of 12° C at the bottom of Ponds 3 and 5 have been measured in August and September. CM-04 should ensure that warm water from the existing or created ponds does not enter Dean Creek, and subsequently the East Fork Lewis River, and cooler water from the bottom of Ponds 3 and 5 will be used to augment flows in Dean Creek during the summer.

Several other CMs are designed to improve habitat conditions in and along Dean Creek including the temperature regime. As part of the water management plan (CM-04), Dean Creek would be prevented from entering Pond 5 during flood events less than approximately the 17-year return period. This would prevent cooler water from Dean Creek from entering and mixing with warmer water in Pond 5. In addition, a riparian buffer planted with native trees and shrubs would be established along the east side of Dean Creek and run the entire length of the Storedahl-owned property. The current riparian conditions along Dean Creek provide almost no shade and consist mainly of non-native species such as Himalayan blackberry and Scots broom. LWD would also be incorporated into the channel to help create more complex, narrower, and deeper channel, which would be more conducive to achieving and maintaining cooler water temperatures. As a result of CMs in the HCP, adverse effects to coastal cutthroat trout are not likely to occur from warm surface water in the ponds entering Dean Creek and, subsequently, the East Fork Lewis River. During the warmest periods of the year, water temperatures and flows are expected to decrease and increase, respectively, in Dean Creek as a result of the implementation of CM-04.

Effects of Groundwater and the Hyporheic Zone on Coastal Cutthroat Trout

Groundwater entering streams (especially small streams) is an important determinant of stream temperatures (Spence *et al.* 1996) and provides localized thermal refugia in stream systems in both summer and winter (Hayashi and Rosenberry 2002). Groundwater temperatures tend to be relatively constant at about the mean annual air temperature, whereas surface water temperatures often vary greatly, both daily and seasonally (Brunke and Gonser 1997). During the summer, groundwater inputs tend to be cooler than surface water, whereas in the winter groundwater is usually warmer than surface water. Therefore, as groundwater contributions increase, temperature variations in the surface stream tend to moderate (Jones and Mulholland 2000). During the summer, ground water discharge areas typically provide refuge from excessively warm stream temperatures that may slow growth because the optimum physiological temperature range has been exceeded (Power *et al.* 1999). High temperatures also lower oxygen solubility and increase susceptibility of fish to bacterial infection (Dunne and Leopold 1978). Fish often move long distances to seek summer refugia offered by groundwater (Barton *et al.* 1985). Surface and groundwater exchanges in alluvial hyporheic zones can be critically important for migratory bull trout because these individuals are especially dependent on the thermal refugia maintained by these exchanges (Frissell 1999).

Hydrologists have long known that surface water and groundwater interact along river systems and research over the last two decades by ecologists and hydrologists has uncovered the functional importance of the hyporheic zone to the physical, chemical, and biological integrity of fluvial ecosystems (Boulton *et al.* 1998). Traditionally, water along river systems has either been defined as surface water or groundwater. However, other bodies or zones of water have recently been defined that are ecotones or intermediate in nature (physically, chemically and biologically) to surface and groundwater. The *hyporheic zone* is a broad term that defines the "saturated interstitial areas beneath the stream bed and into stream banks that contain some proportion of channel water or that have been altered by channel water infiltration (advection)" (White 1993).

The dimensions of the hyporheic zone can vary dramatically depending on the stream size, stream discharge, alluvial porosity and volume, and vertical and lateral exchange rates. In small headwater streams, the hyporheic zone is typically on the order of several meters both vertically and horizontally or entirely absent due to lack of alluvium or significant exchanges of water (streams dominated by uni-directional groundwater input) (White 1993). In large montane and lowland alluvial valleys, the hyporheic zone typically is on the scale of several meters below the streambed and on the order of 100-meters wide. In some highly conductive stream systems (e.g. Flathead River, MT; Yakima River, WA; Methow River, WA), the hyporheic zone can extend over 10 meters deep into alluvium and on the order of 3 km wide across the floodplain (Stanford *et al.* 1994; Stanford and Ward 1988; Stanford and Ward 1993).

In one of the few studies directly addressing the impacts of land use on hyporheic function and ecology, Boulton *et al.* (1997) compared the hyporheic ecology of five small streams in New Zealand under different land uses, for example, native forest, exotic pine forest, and pasture. Many distinct abiotic and biotic differences were observed between the different sites. As expected, the temperatures of hyporheic water at the pasture site were significantly higher than either of the two forested sites. This was attributed to the lack of riparian shading and warmer stream temperatures. Warm water temperatures further reduce the levels of DO in the sediments (Poole and Berman 2001), which can be a critical control on the presence or absence of certain hyporheic taxa. Boulton *et al.* (1997) predict that as stream and hyporheic temperatures warm up due to a lack of riparian shading, the hyporheos community structure can dramatically shift towards a community dominated by a few taxa tolerant of low oxygen (hypoxia) and high temperatures.

Boulton *et al.* (1997) also notes the effects of a lack of a riparian canopy on other physical and ecological processes. They found that the forms of particulate organic matter entering the hyporheic zone differed between sites. Native forests contributed diverse types of leaf materials and woody debris to the hyporheic zone while pasture lands only contributed a few species of grass that decomposed rapidly and contributed little to aquatic production. Boulton *et al.* (1997) found that pasture streams supported significantly less *hyporheos* diversity than the native forest. They largely attributed this to high levels of interstitial fine sediment and the reduction of downwelling oxygen-rich surface water which both promote hypoxic conditions intolerable to some organisms. Although coastal cutthroat trout of the size expected to use the East Fork Lewis River are not known to feed on organisms associated with hyporheic zone, the complex biochemical processes that occur in the hyporheic zone can result in localized inputs of nutrients from the hyporheos to the stream that are then, in turn, used for algae production that subsequently supports invertebrates and forage fish production.

For the purpose of the HCP, a ground water and hyporheic flow analysis was conducted based on data from pre-existing water supply and data collected from 3 piezometers installed in December 1998 and monitored until July 2001 (Sweet *et al.* 2003). Groundwater contour maps (HCP Figures 3-11 and 3-12) were generated from these well measurements, made en masse at several times during the study. Hydraulic conductivity was estimated from the literature, and assumed to be uniform across the analysis area. In addition, a key assumption was that "the water table surface in the alluvial sediments generally reflects surface topography" (HCP, pg. 3-25). This suite of field data and the accompanying assumptions complies with generally accepted engineering practice for water-supply groundwater investigations.

However, a key issue of concern has been hyporheic flow and ecology, and the potential existence of preferential pathways and emergence locations for hyporheic flow, groundwater, and mixtures of the two. In river floodplain sediments, preferential flow pathways abound, due to presence of buried paleochannel deposits. Studies of hyporheic flow find complex patterns even in terrain of relatively uniform surface appearance. These patterns include reaches where dominant flow is from river to floodplain, and seasonal shifts in subsurface water flow direction.

Groundwater gradients, as observed by the network of wells, were small, on the order of 0.003-0.008 ft/ft (HCP, pg. 3-26). In addition, hydraulic conductivities reported in the literature for the shallow alluvial aquifer range over many orders of magnitude (from 0.03 to 70,000 ft/day, with interquartile range form 50 to 900 feet per day, as described by McFarland and Morgan 1996). This would imply that variations in hydraulic conductivity could exert large influences on small-scale flow patterns that would not be detectable from water table elevation information alone.

The literature on field investigation of hyporheic flow reveals that piezometer networks with spacing on the order of a channel width or less are required to investigate these systems (e.g. Huggenberger *et al.* 1998; Kasahara and Wondzell, 2003). Tracer studies are often used to supplement water level observations, and paired piezometers to measure vertical gradients are often employed. Rather than assume that water table gradients are uniform and reflect surface topography, preferential flow is anticipated to follow relic channels indicated by subtle soil and topographic features (Bakke, pers. com. 2004). In short, the spatial resolution of groundwater investigations presented in the HCP is too coarse for characterization of preferential flow, including floodplain hyporheic flow and localized groundwater emergence.

The implications of this difference in spatial resolution are that undetected preferential flow pathways could exist in the vicinity of the proposed expansion, that hyporheic flow could extend further from the current channel than predicted on Figures 3-11 and 3-12, and that localized areas of groundwater/hyporheic water emergence in the river channel could also go undetected.

However, the degree to which the existing Daybreak Mine pits and the avulsion-induced channel instability have already disrupted preferential subsurface water flow pathways and emergence locations is expected to be high. Subsurface flow is already refracted around the existing ponds, as well as intercepted by these ponds and some is converted to surface flow or evaporated. It is possible that ongoing rapid channel evolution could render the type of detailed information on preferential flow discussed above limited in usefulness, even if it were available.

The existing Daybreak Mine ponds are and would remain connected to groundwater and hyporheic flow. Investigations conducted prior to and during HCP development, characterized the extent of hyporheic flow as limited to the existing ponds, but the potential for some fraction of hyporheic flow to flow through the proposed expansion area cannot be ruled out. The general direction of groundwater and hyporheic flow through the Daybreak Mine site generally parallels the direction of flow in the East Fork Lewis River.

Although some warmer water from the ponds can be expected to be incorporated into the groundwater and hyporheic water and eventually flow via groundwater into the East Fork Lewis River, temperatures are expected to moderate as groundwater flows through the alluvial aquifer. This moderation is expected to occur because of the amount of time it would take for pond water to travel via the alluvium to the East Fork Lewis River (which could be 70 to 200 days) (Sweet *et al.* 2003), and the fact that as subsurface water infiltrates the ground and moves downward and towards the streambed, water temperatures tend to equilibrate with the temperature of the subsurface soil layers (Beschta *et al.* 1995). As an example, continuous recorders placed at two locations between the existing ponds and the East Fork Lewis River from November 2000 to December 2001 recorded groundwater temperatures during late summer period that were as much as 9° to 11°C lower than water temperatures recorded in the East Fork Lewis River and the ponds during the same time period.

The effects of advection, or the mixing of stream flow with the flow from groundwater and tributary streams, depend on the relative inputs of these sources to stream discharge. In the East Fork Lewis River, average groundwater inflow rates at RM 10.6 (upstream of the Daybreak Mine site) and 6.5 (downstream of the Daybreak Mine site) were 0.58 and 1.59 cfs, respectively for data obtained in October 1987 (McFarland and Morgan 1996). Mean monthly discharge of the East Fork Lewis River for the month of October is 449 cfs (Hutton 1995). This represents a contribution of groundwater inputs from the Daybreak Mine site to the East Fork Lewis River of significantly less than 1 percent of the total flow of the river. Even if the new ponds captured a significant portion of groundwater or hyporhiec flow, groundwater resources from the Daybreak

Mine site are likely to have little negative or positive effect on either the volume of flow in or the overall temperature of the East Fork Lewis River.

Upon implementation of the HCP and approval for a change in water rights by Ecology, Storedahl would donate 237 afy of their water rights to the State Trust for the enhancement of instream flow in both the East Fork Lewis River and Dean Creek. At the completion of gravel mining and processing, the remaining water rights would be donated for instream flow purposes for a total of 330 afy. Groundwater from the site has been historically pumped and used on 165 acres of agricultural lands at the Daybreak Mine site. Irrigation of agricultural crops or pasture regularly occurs during the driest months of the year (May-September), a time also when stream flows are typically at their lowest levels and stream temperatures are at their highest levels. During May through September, mean monthly discharge of the East Fork Lewis River at the Daybreak Mine site can fall below the mean annual discharge of 1000 cfs and decline to as low as 108 cfs in August (Hutton 1995). Under the HCP, the majority of groundwater (72 percent of the water right) that would normally be pumped for irrigation purposes from May to September would remain as groundwater. The remaining 28 percent would be used to process gravel and to irrigate plantings, and later donated to the State Trust when processing operations are completed (projected to be 15 years) or the term of the HCP expires (25-year term), whichever comes first. This measure would result in the donation, in perpetuity, of 330 afy of groundwater rights or the equivalent of approximately 1.1 cfs if averaged over the irrigation season. This amount of groundwater flow would have a small, but positive effect on base flows and water temperatures in the East Fork Lewis River, in turn, indirectly improving, if only slightly, conditions for coastal cutthroat trout that may utilize the East Fork Lewis River. In summary, groundwater flowing from the existing or new ponds is not anticipated to have a measurable effect on stream temperatures, and therefore, coastal cutthroat trout in the East Fork Lewis River because of the relative size of these inputs compared to flows in the river and the distance groundwater must travel through the substrate before entering the river.

In the case of Dean Creek, advection should not be a factor under the HCP even though stream flows in Dean Creek are relatively low during the summer, because cold water from the bottom of Pond 5 will be used to augmented flows in Dean Creek (CM-04). This water should be substantially cooler than water in Dean Creek and would constitute the majority of flow in Dean Creek during the summer low flow period. Reestablishment of the riparian buffers along Dean Creek would also help moderate temperatures in Dean Creek and in-channel enhancements are designed to create a more defined channel with deep pools. Water temperatures in Dean Creek are anticipated to be measurably cooler and therefore, benefit coastal cutthroat trout because of the addition of cooler water from Pond 5 and improved riparian conditions along the east and south sides of the creek.

Effects of Stranding on Coastal Cutthroat Trout

The reconfigured berm along Pond 5 will be constructed during the first year following issuance of the ITP and other necessary permits, and will restrict coastal cutthroat trout from entering the existing ponds during most flows. The controlled outlet in the berm will be constructed to an elevation equivalent to the elevation of a 17-year return flow restricting lesser flow events from entering the existing ponds. Currently, during flood flows of an approximately 5-year return period, backwater from the East Fork Lewis River can enter Pond 5. Although the reconfigured berm and controlled outlet will reduce the frequency at which flood flows can enter Pond 5, coastal cutthroat trout could potentially enter the Daybreak Mine site via Pond 5 during flood flows greater than a 17-year-return period, and an undeterminable percentage of those fish may become stranded as flood flows recede. Depending on the timing of flood flows, adult or juvenile coastal cutthroat trout could be stranded. Habitat conditions including temperature, predation, and sediment in the existing ponds are assumed to be unsuitable for adult spawning or extended juvenile rearing and, therefore, neither adult or juvenile fish are expected to survive in the ponds for prolonged periods of time.

Pacific Lamprey and River Lamprey

Minimization and Mitigation Measures Benefiting Pacific Lamprey and River Lamprey

Several CMs committed to in the final HCP, directly or indirectly, minimize and mitigate anticipated impacts of covered activities to Pacific lamprey and river lamprey (lamprey). CM-01 commits Storedahl to the installation and operation of a closed-loop wash water clarification system by year three of HCP implementation. The purposes of the closed-loop system is to: 1) substantially reduce or eliminate turbidity discharged from process water and effectively eliminate the discharge of process water to receiving waters (existing ponds); and 2) precipitate dissolved phosphorous and increase the transparency of the pond water. This should result in a decrease in algal growth, subsequently decreasing the decomposition of organic matter and the depletion of DO in the ponds. The closed-loop system would remove solids from the process water and re-circulate back to the aggregate processing system. Solids removed from the system would be run through a belt press, or similar system, to further reduce moisture content. Solids would be temporarily stored on the Daybreak Mine site to dry further and then eventually be incorporated into reclamation actions. Process water from the belt press would be re-circulated back to the aggregate processing system. All water used to wash the gravel would be recycled reducing the demand for water. Relatively small amounts of water would be needed to occasionally recharge the closed-loop system. The closed-loop system would also substantially reduce or eliminate the need to discharge water into the existing ponds as required under the previous washing operation. This, in turn, would greatly reduce the amount of suspended sediment and high levels of turbidity in the ponds that were common under the previous washing process. Implementation of CM-01 indirectly benefits lamprey by improving the quality of water on site and the quality of the water discharged into Dean Creek and, subsequently, the East Fork Lewis River.

CM-02 commits Storedahl to implement a comprehensive storm water and erosion control plan as well as a storm water pollution prevention plan to minimize adverse impacts to water quality as a result of mining and reclamation activities. This measure includes 1) isolating impacts to surface water from mining and reclamation activities; 2) containing and pre-treating surface runoff; 3) re-vegetating bare soils; 4) preventing and managing oil and fuel spills; 5) installing a conveyor to transport mined aggregate; 6) maintaining surfaces on active roads; 7) having a water truck and street sweeper on site, as needed; 8) decommissioning unused haul roads; and 9) specifying in advance conditions that would result in a suspension of operations due to water quality concerns. This measure is designed to manage storm water runoff and potential sources of water contamination on site, before these potential sources of turbidity, suspended sediments, and contamination can enter Dean Creek or the East Fork Lewis River and negatively affect their water quality. Implementation of CM-02 would indirectly benefit lamprey by improving water quality of on-site water and water subsequently discharged to Dean Creek and the East Fork Lewis River.

Storedahl would immediately donate 237 afy of water rights on the property to the State Trust for the enhancement of instream flows in the East Fork Lewis River (CM-03). All water rights associated with the property (330 afy) would be donated to the State Trust, in perpetuity, for instream flow enhancement at the completion of processing operations or the term of the ITP, whichever comes first. Flows in the East Fork Lewis River vary seasonally, with the lowest flows usually occurring during the summer months prior to the onset of fall rains. Donating water rights to the State Trust for the enhancement of instream flows would indirectly benefit lamprey by improving base flow conditions for the East Fork Lewis River and Dean Creek during critical low flow periods.

CM-04 is intended to manage the discharge of pond water to provide seasonal benefits to Dean Creek and to prevent Dean Creek from entering Pond 5 during periods of high flows. By managing the release of pond water and preventing Dean Creek from over flowing into Pond 5 during most high flow events (floods less than a 17-year return period), water quality, including water temperatures, will be improved.

Under CM-05, Stordahl will establish a conservation and habitat enhancement endowment up to 1 million dollars for the monitoring, habitat enhancement, and management of the 300-acre property after the completion of all site reclamation activities. In association with the endowment, Storedahl will grant a perpetual conservation easement on the entire property and convey the property in fee title to one or more conservation-minded groups. These commitments will ensure that reclamation measures implement under the HCP will be maintained and managed in perpetuity for the benefit of all covered species.

Under CM-06 Storedahl would establish native forest on unforested areas within the 100-year floodplain (FEMA 2000), along existing and created ponds, and on upland areas. Initial plantings would occur immediately upon issuance of an ITP and other necessary permits and the remaining plantings would be part of the reclamation activities. In total, 136 acres would be planted to trees providing a future source of shade, soil stability, detrital inputs, and large and coarse woody debris. Implementation of CM-06 would indirectly benefit lamprey by enhancing riparian conditions adjacent to the East Fork Lewis River and Dean Creek.

CM-07, CM-13, and CM-14 would enhance habitat associated with Dean Creek. Dean Creek is currently confined by the J.A. Moore Road bridge and discontinuous levees running along its banks downstream of J.A. Moore Road. An active dairy farm on the west bank of Dean Creek has degraded habitat by denuding streambanks and increasing the nutrient load of the stream. Under high flow conditions, Dean Creek can flow into Pond 5 causing pond water to mix with

Dean Creek resulting in increased turbidity in Dean Creek downstream of Pond 5. In concert with CM-04, Storedahl will implement CM-07 to reestablish the floodplain along the eastern bank of Dean Creek through regrading and contouring to create a series of low terraces to provide overbank functions and to prevent Dean Creek from entering Pond 5 and phases 6 and 7 of the expansion area. Under CM-13, terraces would be planted with native riparian species to enhance soil stability and flow resistance during high flows and a 200-foot riparian management zone would be established adjacent to the Dean Creek along the east bank. This work would be completed during the first five years upon issuance of the ITP.

Following the reestablishment of floodplain terraces on the east bank under CM-07, large woody debris would be added to Dean Creek at a frequency of > 1 piece per 72 feet of channel length. In-channel structures would consist of key pieces of conifer logs that are at least 88 cubic feet in volume. The purpose of CM-14 is to increase habitat complexity in Dean Creek. CM designed to improve habitat conditions in Dean Creek would directly benefit lamprey.

Under CM-08 and 09, Storedahl would incorporate mining and reclamation designs that reduce the risk of an avulsion into the existing ponds and expanded mine area, and that would minimize the effects and recovery time if an avulsion were to occur. All expanded mining would be outside the 100-year floodplain (FEMA 2000), approximately 86 percent of the excavated area would be outside of historic channel locations, as defined by 150 years of observations (Collins 1997), and/or separated from the East Fork Lewis River, by established and regularly maintained roads. The existing ponds would be reclaimed so that there is a wider, vegetated buffer between these ponds and the East Fork Lewis River and the ponds would be narrowed and shallowed to reduce geomorphic recovery should an avulsion occur in the future. Storedahl Pit Road will also be upgraded to protect against an avulsion entering Pond 1. Implementation of CM-08 and 09 would indirectly benefit lamprey by minimizing the potential for and the effects of an avulsion on habitat in the East Fork Lewis River.

Under CM-11, Storedahl would provide labor, equipment, and/or materials in cooperation with public or non-profit groups to enhance East Fork Lewis River floodplain functions and fish habitat related to the protection and recovery of covered species. Although these services may not be specifically directed at improving habitat for lamprey, enhancement efforts in the lower reaches of the East Fork Lewis River would directly benefit lamprey in the East Fork Lewis River.

Effects of Sediment on Pacific Lamprey and River Lamprey

Little information exists about the effects of sediments on Pacific lamprey and river lamprey. The introduction of sediment in excess of natural amounts can have multiple adverse effects on channel conditions and processes resulting in effects on Pacific lamprey and river lamprey survival, their food webs, and water quality conditions, such as water temperature and dissolved oxygen (Rhodes *et al.* 1994). Fine sediments can influence incubation survival and emergence success of species young (Weaver and White 1985), and can also limit access to substrate interstices that are important cover during rearing and overwintering (Goetz 1994; Jakober 1995). Shifts in sediment loads set off a complex of channel responses including changes in pool volumes, depth and frequency, and changes channel morphology (including slope, sinuosity, shape, velocity, flooding regime, and sediment transport) (Rhodes *et al.* 1994; Castro and Reckendorf 1995). Measures committed to in the HCP to minimize and mitigate for the effects of sediments on bull trout and coastal cutthroat trout are expected to minimize and mitigate the effects of sediment on all life stages of Pacific lamprey and juvenile lamprey.

Exposure of lamprey to excess sediment in Dean Creek will occur 8 to 10 hours a day, 5 days a week, from October through June each year during gravel processing operations (the first 10 to 15 years). It is expected that adult lamprey will move out of the area to avoid sediment plumes, and that their use of the area will be precluded until high sediment levels have subsided. Larval and ammoceotes lamprey are less mobile and, therefore, more susceptible to the effects of sediment. The FWS conservatively estimates that turbidity levels which would result in adverse effects to all life stages of Pacific lamprey and river lamprey are reasonably certain to occur in Dean Creek from the Pond 5 outlet to its confluence with the East Fork Lewis River a distance of approximately 1700 feet. Dean Creek currently provides only limited, low quality Pacific lamprey and river lamprey spawning and rearing habitats and, therefore, the anticipated effects from sediments as a result of day-to-day gravel mining and processing are likely to have only negligible impacts on Pacific lamprey and river lamprey populations in the East Fork Lewis River.

Turbidity from day-to-day gravel mining, processing, and reclamation activities that would have an adverse affect on lamprey is not anticipated to reach the East Fork Lewis River because sediment from the ponds is expected to settle out in Dean Creek before reaching the East Fork Lewis River.

Effects of Temperature on Pacific Lamprey and River Lamprey

Although little information exists on the temperature requirements for Pacific lamprey or river lamprey, new information from a study suggests that optimal water temperatures for egg development are 10° C to 18° C (Bayer *et al.* 2000). Temperature may also be a determinate of ammocoete abundance (Young *et al.* 1990; Youson *et al.* 1993). River lamprey spawn in late winter through early spring while Pacific lamprey spawn in the spring. Eggs can remain in the gravel for up to two weeks depending on water temperatures. Water temperature data collected for the East Fork Lewis River indicate that temperatures do not exceed optimal for lamprey egg development until late-May. Spawning and emergences is expected to occur prior to then.

As a result of CMs in the HCP, adverse effects to lamprey are not likely to occur from warm surface water in the ponds entering Dean Creek and, subsequently, the East Fork Lewis River. During the warmest periods of the year, water temperatures and flows are expected to decrease and increase, respectively, in Dean Creek as a result of the implementation of CM-04. Pond water during other periods of the year is decidedly cooler. Warm water from the ponds can also flow via the alluvium to Dean Creek or the East Fork Lewis River, although the distance traveled and time required for this water to reach the receiving waters allows for the moderation of temperatures. As a result of conservation measures in the HCP, surface water and groundwater resources originating from the Daybreak Mine site are likely to have little negative or positive effect on either the volume of flow in or the overall temperature of the East Fork Lewis River. As a result, adverse effects to lamprey related to the temperature of surface water or groundwater are not likely to occur during the implementation of the HCP.

Effects of Stranding on Pacific Lamprey and River Lamprey

The reconfigured berm and controlled outlet along Pond 5 will be constructed during the first year following issuance of the ITP and other necessary permits, and will restrict lamprey from drifting into (larval or ammocotes) or entering (adult) the existing ponds during most flows. The controlled outlet will be constructed to an elevation equivalent to the elevation of a 17-year return flow restricting lesser flow events from entering the existing ponds. Currently, during flood flows of approximately 5-year return period, backwater from the East Fork Lewis River can back into Pond 5. Although the reconfigured berm and outlet will reduce the frequency at which flood flows can enter Pond 5, lamprey could potentially enter the Daybreak Mine site via Pond 5 during flood flows greater than a 17-year return period, and an unknown percentage of those lamprey may become stranded as flood flows recede. Depending on the timing of flows, adult or ammocoetes could be stranded in this manner. Some lamprey may be able to exit pond 5 via the overflow structure. Ammocoetes are rarely found in stagnant or eutrophic water (Potter 1980), and likely would not survive long in trapped in the existing ponds. In general, habitat conditions including temperature, predation, and sediment in the existing ponds are assumed not to be suitable for adult lamprey or ammocoetes and, therefore, neither, once trapped, are expected to survive in the existing ponds for prolonged periods of time.

Oregon Spotted Frog

Oregon spotted frog are not known to occur on the Daybreak Mine site or in Clark County. Although not currently present, much about the status of Oregon spotted frog could change over the 25-year permit term as new populations are found and/or reintroduction of the species to its former range occurs. Historically, Oregon spotted frogs occurred throughout the lowlands of the Puget Trough in Washington (McAllister and Leonard 1997) potentially including wetlands adjacent to the East Fork Lewis River. Populations verified by museum specimens had occurred in Vancouver and Orchards, Clark County, Washington. The closest known existing populations to the Daybreak Mine site are located in Thurston and Klickitat Counties.

Minimization and Mitigation Measures Benefiting Oregon Spotted Frog

Several CMs committed to in the final HCP, directly or indirectly, minimize and mitigate anticipated impacts to Oregon spotted frogs and Oregon spotted frog habitat. CM-17 commits Storedahl to survey the 300-acres Daybreak Mine site for the presence of Oregon spotted frogs, if the species is first determined to reside in Clark County. If breeding frogs are found on site, exclusion fences would be constructed to prevent frogs from accessing areas where mining, reclamation, processing, or other mine-related activities are on-going. This measure is designed to avoid the take of Oregon spotted frogs, if present, from covered activities.

Under CM-05, Stordahl will establish a conservation and habitat enhancement endowment up to 1 million dollars plus earnings for the monitoring, habitat enhancement, and management of the 300-acre property after the completion of all site reclamation activities. In association with the endowment, Storedahl will grant a perpetual conservation easement on the entire property and convey the property in fee title to one or more conservation-minded groups. These commitments will ensure that reclamation measures implemented under the HCP will be maintained and managed in perpetuity for the benefit of all covered species.

CM-16 indirectly benefits Oregon spotted frogs by committing to proactive measures to eliminate or control the number of non-native predatory fish by removing fish that reside in the existing ponds and by developing educational signs informing the public of the dangers of releasing non-native fish into ponds adjacent to streams, rivers, and wetlands. As part of CM-16, targeted harvest of non-native predatory fish in the existing ponds would occur in years 5, 10, and 15 to reduce numbers. Rock barriers between ponds would also be created and maintained to prevent fish from moving between ponds, both existing and new ponds. CM-08 would also indirectly affect the numbers of non-native predatory fish by narrowing, reshaping, and shallowing the existing ponds. Although this measure was designed to address avulsions, it also would eliminate much of the deep, open water habitat where non-native predatory fish occur. The introduction of non-native species has been cited as a major factor in the decline of Oregon spotted frog (McAllister and Leonard 1997). CMs designed to reduce or eliminate non-native predatory fish in the existing ponds and prevent the spread of the fish to the new ponds would benefit all native amphibians including the Oregon spotted frog, when present.

In addition to educating the public about the unintended effects of introducing fish like large mouthed bass into the existing and new ponds, Storedahl has committed to limiting public access to the site (CM-18). Public access would be controlled by decommissioning unnecessary roads, placing vehicle barriers, and developing foot trails. During operational phases of the HCP (15 years), on-site security agents would also restrict public access to the site. These measures would help to minimize disturbance to sensitive sites, i.e. existing wetlands, newly reclaimed habitats, thereby, minimizing disturbance to amphibians, including Oregon spotted frog that may colonize the site following mining and reclamation activities. Such a measure would also help reduce the incidents of non-native predatory fish being covertly stocked in existing and new ponds.

Under CM-15, Storedahl commits to creating 84 acres of emergent (32 acres) and forested (52 acres) wetlands during and immediately following mining activities. Within the wetlands, Storedahl would incorporate structural elements such as logs and root wads to provide substrate and cover for aquatic species including invertebrates, amphibians, and fish. Wetlands would also be seeded or planted with a variety of native species of wetland flora indicative of those commonly found in wetlands associated the East Fork Lewis River floodplain. All but one of the four existing, small wetlands would be protected under the final HCP. All existing or created wetlands following mining and reclamation would be protected in perpetuity by conservation easements (CM-12). Once established, these wetlands would provide habitat for native amphibian species, potentially including the Oregon spotted frog.

Habitat Effects on Oregon Spotted Frog

Habitat loss is cited as a major factor contributing to the decline of Oregon spotted frogs especially in the Puget Trough region. Historically, wetlands have been drained or filled to accommodate human uses such as agriculture or residential development. Previous to gravel mining, the Daybreak Mine site was cleared and farmed. Portions of the site are still leased for row crop or hay production. Many of the habitat features preferred by Oregon spotted frog that once may have existed on the Daybreak Mine site were likely cleared and filled for agriculture purposes. As a result, few wetlands that could provide habitat for Oregon spotted frogs exist on the site presently. Based on a recent wetland delineation (Ecological Landscape Services Inc. 1998), four wetlands totaling approximately two acres are located on the Daybreak Mine site. This does not include wetland habitat associated with the fringes of the five excavated ponds which are considered to be created wetlands and are probably unsuitable because of the existence of predators, i.e. bullfrogs, largemouth bass in the ponds.

As proposed in the final HCP, only one of the four delineated wetlands on the 300-acre Daybreak Mine site will be excavated for gravel. This wetland, identified as wetland B in the Wetland Delineation Report (Ecological Landscape Services Inc. 1998), is located in the northwest corner of the property. The report classifies wetland B as an emergent, seasonally flooded and farmed, wetland of approximately 0.25 acres in size. It is isolated from the East Fork Lewis River, but occasionally is recharged by surface flooding from an ephemeral stream off a hillside north of the Daybreak Mine site. In most years, the wetland supports agricultural crops or hay, at least for the last several decades (Ecological Landscape Services Inc. 1998). This wetland is seasonally maintained by groundwater and periodic overland flow. As a result, its value to amphibians, including Oregon spotted frog would be limited and seasonal in nature. The wetland area dries up in late spring or early summer, it is planted in row crops or hay, eliminating most of its value for amphibians. Therefore, Oregon spotted frog use would also be expected to be seasonal.

Under the HCP, the topsoil of wetland B would be stripped by year 10 and stockpiled for later use in reclamation activities. Prior to these, it would provide some habitat as described above. Gravels from the substrata would be excavated as part of Phase 6 to a maximum depth of 37 feet. All wetland habitat functions provided by wetland B for amphibians, including habitat for Oregon spotted frog, would be lost at that time under the proposed action. The final reclamation plan does call for the creation of 84 acres of forested and emergent wetlands that would be protected, in perpetuity, with conservation easements. In addition, the remaining three wetlands identified in the delineation report (Ecological Landscape Services Inc. 1998) would not be directly impacted by the proposed mining project and would be included in the perpetual conservation easement. Wetland habitats created by reclamation activities are expected to provide habitat for amphibians including Oregon spotted frog. Although no direct impacts to Oregon spotted frogs are expected to occur as a result of the excavation of wetland B, since it will remain a feature on the land for approximately the first 10 years of HCP implementation, use by Oregon spotted frogs can not be ruled out completely.

Disturbance/Injury/Mortality of Oregon Spotted Frogs

Predators including large mouth bass and bull frogs are known to occur in the existing ponds. Other species such as northern pike minnow could also occur in these ponds. Their presence creates unsuitable conditions for Oregon spotted frogs. Although Storedahl may not be responsible for the introduction of these species to the existing ponds, none-the-less, the existence of the species could result in the death or injury to Oregon spotted frog, when present. Measures to eliminate or significantly reduce the numbers of these species in the existing ponds during years 5, 10, and 15 are committed to in the HCP and should minimize the impacts of predators on Oregon spotted frogs. Under CM-08, habitat conditions will be modified to minimize the scope and depth of these features. Although this measure was intended to minimize the effects of an avulsion should one occur, it will also substantially reduce the habitat suitability of Ponds 1, 2, and 3 for predators. In addition, educational signs will be erected to inform the public about the dangers to native species as a result of introducing non-native species to wetlands and ponds on site. Even with the implementation of these measures, the removal of all predatory species is unlikely, and such predation would have negative consequences for Oregon spotted frogs.

Heavy equipment traffic is expected to increase over current conditions and more areas within the 300-acre Daybreak Mine site are expected to be subject to such traffic at least for the first 10 to 15 years of the plan. After that, most of the mining and reclamation activities would have been completed, reducing the need for trucks and other heavy equipment. Oregon spotted frogs, if present during the permit term, could be inadvertently killed on haul roads or in areas where excavations are planned. Although such occurrences can not be ruled out, they are expected to be extremely rare based on the current status of Oregon spotted frogs in Clark County, i.e. are not known to presently occur in Clark County, and further minimized by protective measures committed to in the final HCP. Under CM-17, surveys for Oregon spotted frogs would be conducted on the 300-acre Daybreak Mine site, if there is a change in the frog's status within the county, i.e. determined to occur in the Clark County. If such surveys conclude frogs are present on site, exclusion fences would be installed to minimize traffic/frog interactions.

In summary, Oregon spotted frogs are not known to occur on the Daybreak Mine site, and are not likely to occur during the active mining and processing phases of the proposed project. Measures committed to are intended to minimize the direct take of Oregon spotted frogs via exclusionary fencing and the direct (removal from ponds) and the indirect (educational signs) control of predators. In the long-term, the creation of suitable habitat could provide areas for Oregon spotted frogs to colonize the site. The creation of a conservation easement and the fee simple transfer of the property including the endowment to manage the property to a conservation-minded group will also facilitate colonization of the site by Oregon spotted frogs by ensuring long-term maintenance of wetland habitats.

Effects of Inorganic Flocculants, Coagulants, and Polymers on Covered Species

The commitment in the final HCP is to reduce discharge water turbidity by half or more than the current Ecology-permitted level of 50 NTUs. During the first 3 years of HCP implementation, Storedahl will wet process gravel. This system will mix flocculants and coagulants with pond water in a long, sinuous channel that empties into Pond 1. After the first 3 years, Storedahl has committed under CM-01 to install and operate a closed-loop wash water clarification system to remove solids from the process water and re-circulate the water back into the closed-loop system. Implementation of the closed-loop system will substantially reduce or eliminate discharge of process water into the existing ponds. The benefits to covered species of the closed-loop system are the reduction of turbidity in pond water, the elimination of the need to discharge process water directly into the ponds, and the reduction of water needed to process gravel.

In preliminary tests of the wash water treatment system anticipated to be used the first 3 years, Storedahl has been able to achieve NTU levels of less than 10 NTUs (Sweet *et al.* 2003). Lower turbidity levels and smaller amounts of discharge water, in turn, mean less sediment that could potentially reach Dean Creek and, subsequently, the East Fork Lewis River during the active processing of gravel. Less discharge water also means that less water is need to process gravel, allowing Storedahl to donate a substantial potion of the property's water rights to instream flows per CM-03. The remaining water rights used to operate the closed-loop system and irrigate plantings will be donated at the end of mining and processing activities. Although the use of additives will reduce turbidity, eliminate the discharge of process water to the ponds, and minimize the use of water during gravel processing, thereby, benefiting covered species, potential negative effects may result from exposure to low levels of chemicals. Potential negative effects of treated sediments being mobilized during an avulsion are discussed later in this section.

One potential negative effect of using the current wet-processing system is the introduction of chemical additives to process water. Exposure pathways during the first 3 years prior to the implementation of the closed-loop system consist of additives in solution and additives absorbed to fine grain particulate and organics. During previous gravel washing operations that used chemical additives (NALCO 7888), Storedahl monitored the process water discharge and the receiving waters (existing ponds) for aquatic toxicity following Ecology's Whole Effluent Toxicity Testing and Limits guidance (WAC 173-205). Toxicity testing results from 15 tests indicated that the water treated with these additives was not toxic to rainbow trout fry (100 percent survival) or Daphnia magna (95 percent survival). However, sublethal effects were not evaluated.

Under MEM-01 in the final HCP, Storedahl will continue the quarterly whole effluent toxicity testing of the treated process water while the closed-loop clarifier is in the design, pilot testing, and construction phases. Quarterly reports on the results will continue to be submitted to Ecology, and annual summary reports will be provided to the FWS. Additives were previously dosed at the mixing tank at a concentration of approximately 27mg/l (order of magnitude less than the LC50 of 475 mg/l). With the addition of groundwater entering the ponds, the dosing concentration in Pond 1 is further reduced to approximately 19mg/l in the winter and 23mg/l during the summer. These concentrations assume no mixing with sediments has occurred. Assuming 90 percent of the additive has been adsorbed in the mixing channel, concentrations of the additives in solution would be approximately 2mg/l at the point where Pond 1 discharges into Pond 2. At this rate, all additives would be spent before reaching the discharge at Pond 5. Sediments treated with the additives would primarily remain in Pond 1. Approximately 1 to 2 percent of the treated sediments are anticipated to overflow into Ponds 2 and 3. Under the HCP, treated sediments in the existing ponds will be covered (essentially capped) with several feet or more of clean imported fill and a minimum of 18 inches of topsoil per CM-08 in order to reshape and narrow the footprint of Ponds 1, 2, and 3. The topsoil will be vegetated with emergent and forested wetland plant species. Because of their affinity to be readily adsorbed by sediments, additives are also not expected to enter groundwater via the ponds. In addition to the low concentration of additives in the ponds, additives are expected to be adsorbed by sediments that line the ponds or with sediments in the alluvium. Impacts to covered species in Dean Creek and the East Fork Lewis River are not expected to occur based on previous testing of this system, the assumption that additives will be spent (adhered to fines or organics) in the ponds, and the assumption that additives will not enter the groundwater.

Once the closed-loop system is operational (year 3), the discharge of process water will be almost entirely eliminated. Most process water will be recycled back to the aggregate processing equipment. The remaining process water will be carried with sediments to the upland stockpile site or an inconsequential amount lost to minor leakage or evaporation. Since virtually all discharge to the ponds will be eliminated, the exposure pathway described previously under the interim system will also be eliminated. The final design of the closed-loop system and chemical additives will be developed in consultation with the Services, Ecology, and other appropriate permitting agencies. This should help ensure that chemicals known to be toxic or have sublethal effects to covered species will be not be permitted. Other additives would be thoroughly investigated before being considered. The FWS also assumes that, through this process, additives used in the closed-loop system will be no worse than the additives previously used and analyzed in this document. Prior to construction of the final closed-loop treatment system, Storedahl will move a scaled down pilot plant to the site to test the effectiveness of various configurations and additive(s) under a range of discharge conditions. This pilot testing will provide an opportunity to sample the product, i.e., flocculated sediment, and perform toxicity testing before selecting which additive(s) and clarifier system will be assembled at the site. The closed-loop clarifier would be located outside the 100-year floodplain (FEMA 2000) but still within the 23-acre processing area. All chemicals will also be stored outside the 100-year floodplain (FEMA 2000).

Upon implementation of the closed-loop system, toxicity and bioaccumulation testing will focus on treated sediments and will follow the *EPA Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* (EPA 2000). This testing procedure employs amphipods *(Hyalella azteca)*, midges *(Chironomus tentans)*, and oligochaetes (*Lumbriculus variegates*) to measure toxicity above, on the surface, and within the sediments. Also upon selection of the final closed-loop clarifier system and additive(s), quarterly whole sediment testing results will be provided to Ecology and annual summary reports will be provided to the Services. In addition, sediments placed for reclamation purposes will be capped with a minimum of 18 inches or topsoil.

A second potential exposure route is through an accidental catastrophic release of the additives used in the existing process water clarification system or the future closed-loop clarifier system. Additives previously stored at the site were near Pond 1 in a 5,100-gallon double-walled tank and/or within a metal building designed with a secondary containment component. Before the processing of gravel occurs under the HCP, the chemical additives and storage facilities will be moved to an upland area outside of the 100-year floodplain (FEMA 2000), and supply lines will be buried. This will reduce the chances that a spill will enter the existing ponds at the rates described below.

The Storm Water Erosion Control Plan and Storm Water Pollution Prevention Plan in the final HCP Technical Appendix D includes spill prevention measures in Section 5.2.2, and emergency spill containment and reporting measures in Section 5.3. However, assuming a worst case scenario, such as the release of all the additives contained in the 5,100 gallon double-walled tank at current location, the concentration of the additive(s) in the existing or reconfigured ponds post-reclamation can be estimated. Note that these additives are designed to be highly soluble in water. As an example, if NALCO 7888 is stored in the tank, a release of 5,100 gallons of NALCO 7888 would likely result in a portion being adsorbed to the soil into the vicinity and the balance running into Pond 1, where it would mix with water and some suspended sediments. The overflow would enter Ponds 2, 3 and 5, with additional mixing occurring prior to discharging into Dean Creek. These ponds have a combined volume of 535 acre-feet. Complete mixing of the NALCO 7888 would result in a concentration of approximately 37 mg/l in the pond water. The reported LC50 for NALCO 7888 for rainbow trout is 475 mg/l, an order of magnitude higher than the resulting pond concentration of 37 mg/l. A similar calculation for the reconfigured ponds (under CM-08) with a final volume of 306 acre-feet results in a concentration of approximately 64 mg/l, still well below the LC50. It is expected that containment and cleanup response would result in even lower concentrations in the ponds than calculated in the above example.

Covered species in the immediate vicinity of the spill are more likely to be adversely affected by an accidental spill of chemical additives, but it is anticipated that the chemical will be quickly diluted to sub-lethal concentrations as additive mixes with large volumes of water in Pond 1, 2, 3, and 5. Lamprey and coastal cutthroat trout that may have entered the existing ponds during flooding events on Dean Creek, described previously, are the only covered species likely to be present in the existing ponds during normal day-to-day processing operations and, therefore, are most likely to be killed or injured during a chemical spill. Bull trout are not expected to enter the existing ponds because they are not expected to utilize Dean Creek at any time during the life of the plan. Oregon spotted frog are not currently known to occur in Clark County, but we believe that over the permit term there is a likelihood that Oregon spotted frog could colonize the Daybreak Mine site. If presence on site is determined through required surveys, exclusionary fencing will be erected to prevent frogs from entering areas where active mining and processing operations are occurring and where chemicals are stored. When present, it is possible that some Oregon spotted frogs may be exposed to chemicals during a spill.

Flocculants, coagulants, and polymers released into the ponds during an accidental spill could potentially enter Dean Creek and the East Fork Lewis River where they could combine with sediments causing them to settle out more quickly than anticipated under normal stream processes. By way of example, winter discharges from Pond 5 into Dean Creek range from 2.9 to 5.1 cfs (HCP Table 6-2), while the Dean Creek 2-year (bank full) discharge is approximately 164 cfs (HCP Technical Appendix C, Table 4-4). If a worst case spill occurs during winter high flow, as described above, the concentration of the additive in the pond water would either be further diluted by the flow of Dean Creek and/or attached to sediments suspended in the flow. With a flow of 2.9 to 5.1 cfs from the ponds, the concentration of additive in Dean Creek would be 1 to 2mg/l, less than 7 percent of the optimum feed to affect treatment of the process water, which was added at an average dose of 27.7mg/l during system testing (HCP Technical Appendix G). This concentration would be less than 1 percent of the LC50 for the additive.

However, even low doses of additive in Dean Creek could result in increased rates of settling of fine sediment and organics in Dean Creek. It is expected that the naturally high turbidity levels in Dean Creek winter runoff would adsorb the additive leaving the pond, and settle in the streambed and/or carried with overbank flow and deposited onto Dean Creek's floodplain. Higher rates of settling, in turn, could lead to higher rates of habitat degradation including the loss of spawning substrate for species that spawn in Dean Creek (coastal cutthroat trout and lamprey), and the loss of interstitial spaces used by aquatic macro-invertebrates (prey species of bull trout and coastal cutthroat trout). During the summer months the surface discharge from Pond 5 is 0.3 cfs or less (HCP Table 6-2). Under CM-04 Water management plan, this discharge is pumped from the bottoms of Ponds 3 and 5. Simply stopping the pumping to Dean Creek, and possibly redirecting it to riparian irrigation would eliminate the discharge of spilled additive into Dean Creek. Because of this, spills during low flow conditions are not expected to reach Dean Creek. Containment facilities and spill responses measures in the HCP would minimize the amount of chemicals that enter Pond 1, and further mixing of the chemicals with water in ponds 1, 2, 3, and 5 would further dilute the concentration of these chemicals prior entering Dean Creek via the controlled outlet. Additional dilution of the additive leaving the ponds into Dean Creek, as well as the availability of turbid water in Dean Creek's natural flow to further adsorb the diluted additive, would likely result in the additive being 'spent' long before it reaches the East Fork Lewis River. Therefore, no adverse effects to covered species resulting from a spill of chemical additives in Pond 1 are expected to occur in the East Fork Lewis River. Impacts as a result of increased sedimentations to the habitat of covered species that utilize Dean Creek are more likely to occur and could lead to a temporary loss of some spawning habitat. Dean Creek currently provides only limited, low quality spawning for coastal cutthroat trout, Pacific lamprey, and river lamprey and, therefore, the anticipated effects from sediments due to a catastrophic spill of additives are likely to have only negligible impacts on coastal cutthroat trout, Pacific lamprey and river lamprey populations in the East Fork Lewis River.

Effects of an Avulsion on Covered Species

Previous mining has resulted in the creation of five unnamed ponds that cover an area of approximately 64 acres. Mining and processing at the site began in 1968 and the site has operated under a WDNR's Surface Mining Permit since 1971. Three previous owners mined gravel from all or part of what are now referred to in the final HCP as existing Ponds 1, 2, 4, and 5. Storedahl began gravel mining and processing at the site in 1987. Under their ownership, Pond 3 was excavated as well as a portion of Pond 1. All gravel extraction at the Daybreak Mine site concluded by 1992, prior to the listing of bull trout. This constitutes the existing site conditions at the Daybreak Mine site prior to Storedahl developing a HCP and applying for an ITP.

Unlike the proposed excavations, the five existing ponds are located entirely within the 100-year floodplain (FEMA 2000) meaning they are in closer proximity to the river than the proposed excavations and are entirely within historic channels delineated from cadastral surveys from the mid-1800s to present times (Collins 1997). Therefore by nature of their juxtaposition, the existing ponds are more susceptible to flooding and an avulsion. An avulsion event occurred at the Ridgefield Pits in November of 1996. During that event, the East Fork Lewis River captured a series of 9 pits before rejoining with its channel at approximately RM 7.5. As part of CM-10, Storedahl will be investigating the Ridgefield Pits to assess current habitat conditions, to assess fish use, and to provide information to refine the contingency plan to minimize the negative effects of an avulsion should one capture all or part of the Daybreak Mine ponds.

Avulsions are naturally occurring dynamic processes on rivers that tend to eliminate as well as create habitat on which fish species depend. For example, avulsions can create wall-based channel habitats for rearing juvenile salmonids, new sources of spawning gravel for adults, and new sources of LWD. At the same time, portions of the old channel can be abandoned. As a result, redds or spawning habitat could be dewatered and fish could be stranded. Sediment could also be released downstream smothering redds and spawning habitat and/or interfering with the foraging behaviors of adults and juveniles salmonids. In situations where the stream channel avulses into a portion of the floodplain that contains manmade features such as excavated ponds, negative effects may be more pronounced. The effect can be an increase in disturbance frequency and an increase in recovery time for the reach. Negative effects summarized by Norman *et al.* (1998) may include: 1) lowering the river bed upstream and downstream of the site, 2) eroding of footings for bridges and utilities, 3) changing aquatic habitat, 4) simplifying the complex natural stream system, 5) increasing suspended sediment, and 6) abandoning reaches of spawning gravels or rearing habitats. As recovery of river through the avulsed pits proceeds, many of these negative effects become diminished. Norman *et al.* (1998) also suggests that through careful siting, planning, limited mining, a thorough hydrological analysis, use of alternative sources, and an innovative reclamation plan that some mining impacts can be reduced and mitigated.

Avulsions are triggered by unpredictable, random events such as LWD jams, landslides, large floods, or upstream changes in river position and, therefore, it is not possible to predict when or necessarily if an avulsion will occur. However, the relative risk to one location along a river versus other locations can be qualitatively evaluated to determine the potential location of any future avulsion. The final HCP was developed with the understanding that an avulsion into the existing ponds could occur during the 25-year term of the ITP. Without the final HCP, it is unclear if any long-term plan would be developed to monitor existing conditions with respect to an avulsion, to prevent or minimize the effects of an avulsion, and to ensure that adequate funding and resources would be available to respond to an avulsion. Several potential avulsion paths capable of capturing one or more of the existing ponds were described and analyzed in Technical Appendix C of the HCP (WEST Consultants 2001). This analysis does not imply that an avulsion will definitely take place at the indicated locations but, rather, if an avulsion was to occur, the identified locations have a greater potential for an avulsion than other locations considered. Of the three avulsion paths identified that would lead to the capture of one or more of the existing ponds, the avulsion path at RM 9.0 that would capture two county pits, erode through Storedahl Pit Road, and enter Daybreak Mine Pond 1, is anticipated to have the greatest potential impact on covered species. This avulsion scenario will be analyzed with respect to covered species. Other avulsion scenarios discussed in the HCP and Technical Appendix C, including an avulsion into the proposed pits could have similar types of impacts on covered species, but to varying degrees.

Minimization and Mitigation Measures

Activities conducted under the HCP are not expected to significantly increase the risk of an avulsion into the existing ponds. However, Storedahl has developed several CMs designed to prevent, minimize, and mitigate for the effects of an avulsion through one or all of the ponds. An avulsion is less likely to occur in the new ponds, wetlands, and depressions created in the expansion area because of their reduced proximity to the active channel, and the fact that they are located almost entirely outside documented, historic channel locations (last 150 years) (Collins 1997). In the event that an avulsion were to occur in the new ponds and wetlands created by the proposed mining activities, these features will be purposefully configured to be long and narrow and parallel to river flow as suggested by Norman *et al.* (1998) to minimize adverse effects of an avulsion and to allow for a faster recovery of riverine habitats. To prevent or lessen the effects of an avulsion from entering the existing ponds, Storedahl will, upon issuance of the ITP and other necessary permits, begin to plant native tree species in areas within the 100-year floodplain (FEMA 2000), upland areas, and around the perimeter of the existing ponds in order to establish native valley bottom forest (CM-06). Trees will also be established in suitable areas during the reclamation of the proposed expansion site. In total, 136 acres would be planted to trees providing a future source of shade, soil stability, detrital inputs, and large and coarse woody debris. Trees will also increase channel roughness and decrease the energy of flood flows. Many of those trees will be 20 to 25 years old at the end of the permit term.

Under CM-08, Storedahl commits to several measures that are designed to reduce the risk of an avulsion and to ameliorate negative effects of flooding or an avulsion should such an event occur. CM-08 incorporates mining and reclamation designs that 1) forgo mining on portions of the property that are closest to the channel and riverward of any manmade infrastructures (roads); 2) conduct approximately 86 percent of all surface excavation outside of pre-settlement channel locations, as defined by 150 years of historical observations; 3) reclaim 36 acres of the excavated areas within the area of historic channels to forested or emergent wetland; 4) reduce existing open water areas from approximately 64 acres to approximately 38 acres by narrowing and reshaping ponds, and thereby eliminating any elevation difference between the thalweg of the river and the bottom of the existing ponds, as well as creating a wider vegetated buffer between the East Fork Lewis River and the existing ponds and the existing ponds and the proposed expansion area; 5) configure new ponds parallel to the river channel per Norman *et al.* (1998) and minimize overall width and depth of new ponds during reclamation; and 6) adaptively manage reclamation activities based on Ridgefield Pit studies (CM-10).

Under CM-09, a contingency plan will be developed and implemented to prevent and mitigate for an avulsion into the gravel ponds on the Daybreak Mine site. Three pathways have been identified that represent the most probable future avulsion paths. Proactive measures like the protection of the Storedahl Pit Road will be put in place during the first few years of HCP implementation. Other measures would be implemented if monitoring suggests more actions are needed. Solutions will be designed and completed in consultation with Clark County, WDFW, and other permitting agencies, as well as with the approval of the Services. Preventing an avulsion into the site during the term of the HCP will minimize the potential for an avulsion into the Daybreak Mine site and allow for other minimization and mitigation measures such as pit reclamation and plantings to become established. At the end of the permit term, Storedahl, the Services, WDFW, Clark County, and other permitting agencies, as well as the future land owner(s) and/or easement holder(s), can make a decision to remove this material to accommodate future channel migration or leave it in place to continue to provide a certain level of protection against an avulsion post-permit term.

CM-10 commits Storedahl to investigate water temperatures, DO, fish use, and geomorphology associated with the nearby Ridgefield Pits. These post-avulsion studies will 1) assess the influence of pools on fish habitat and fish use; 2) assess the influences of the pools on the East Fork Lewis River water temperatures and DO levels; 3) assess pool volumes, channel shape, and sediment infill rates; and 4) provide information to refine the contingency planning efforts to minimize negative effects in the event of an avulsion into the Daybreak Mine site. Information obtained from these investigations will be used to fine tune reclamation efforts of the existing Daybreak Mine ponds and proposed excavations, and provide insight into facilitating fish recovery efforts should avulsion into the Daybreak Mine occur.

Labor, equipment, and/or materials will be provided to public non-profit groups to enhance floodplain functions related to protection and recovery of covered fish species within the East Fork Lewis River Basin (CM-11). These in-kind services add up to $25,000 per year for years 3 through 12 of the HCP for restoration activities. Under the HCP, Storedahl will work with the LCFRB to review and select projects eligible for funding. Projects funded and constructed under this measure will be subject to all federal, state, and local permitting processes including section 7 consultation, if necessary. Therefore, the effects of these projects are not included in this Opinion.

To fund habitat monitoring, habitat management, and response to events such as an avulsion or severe flooding after the ITP has expired, or on lands that have been donated in fee title during the ITP term to an approved conservation group(s), Storedahl will establish an irrevocable conservation and habitat enhancement endowment of one million dollars. The fund will be generated by a surcharge of seven cents per ton of sand and gravel mined from the Daybreak

Mine site. Funds and interest accrued cannot be used by Storedahl to fulfill other obligations committed to in the HCP during active mining and restoration at the site.

Sediment Effects of an Avulsion on Covered Species

The final HCP was developed with the understanding and assumption that an avulsion into the existing ponds is reasonably certain to occur during the 25-year term of the ITP. Without the final HCP, it is unclear if any long-term plan would be developed to monitor existing conditions with respect to an avulsion, to prevent or minimize the effects of an avulsion, and to ensure that adequate funding and resources would be available to respond to an avulsion. Although the Service considers the existing ponds part of the existing baseline conditions at the Daybreak Mine site, certain gravel processing, storm water management, and reclamation activities proposed by Storedahl could alter those baseline conditions over the permit term. These activities could contribute to the amount of fine and coarse sediments already present in the existing ponds and would potentially contribute to the negative consequences of an avulsion, should one occur during or following the full implementation of the HCP. Although the placement of these materials will have short-term adverse effects on covered species, reclamation efforts are intended to reduce the recovery time of this reach of the East Fork Lewis River in the event of an avulsion.

During the first 3 years of HCP implementation, Storedahl will continue to use the existing ponds to treat process water generated from gravel mined from the Daybreak site as well as off-site sources. Processing during this period would be either by dry processing or wet processing with the aid of flocculant(s)/coagulant(s) for treatment. Based on information in the final HCP, approximately 20,000 cubic yards of fine sediment (from on-site and off-site sources) are expected to be generated annually from processing activities. Over the first 3 years, wet processing activities would result in approximately 60,000 cubic yards of fine sediments treated with flocculants and coagulants being directly discharged into the existing ponds with the majority of that sediment settling out in Pond 1. If sediments generated during the 3 three years of gravel processing entered the East Fork Lewis River or Dean Creek during an avulsion, the effects on covered fish species would be similar to the effects of sediment described previously in this Opinion. After year 3, a closed-loop water clarification system (CM-01) would be utilized to separate fines from process water. Fines separated from the process water would be run through a belt press and temporarily stored in an upland area to dry. After drying, these fines, with the addition of topsoil, will be mostly incorporated into reclamation activities in the new ponds and wetlands created following mine expansion. Once the closed-loop system is operational, the existing ponds will not be needed to treat process water. At this point, fines entering the ponds will be limited to stormwater runoff during normal day-to-day gravel mining and processing activities and, therefore, fines generated from gravel processing would no longer be available to be mobilized during an avulsion into the existing ponds.

An avulsion through any or all of the existing ponds has the potential to suspend all or a portion of the sediment in the existing ponds and transport this material downstream. Although some of this sediment represents baseline conditions, Storedahl will be responsible for placing fine and coarse sediments, including sediments treated with flocculants and coagulants, into the existing ponds as part of normal gravel processing and mining reclamation efforts. Up to 571,000 cubic yards of material from on- and off-site sources will also be used to fill, reconfigure, and reclaim the existing ponds. The filling and reconfiguring of the existing ponds will commence during the first year of HCP implementation. Once placed and consolidated, fill material will be vegetated with emergent and forest wetland species native to the area. Off-site sources of fill will require a Level 1 environmental assessment prior to acceptance of the material to ensure the material is clean and uncontaminated as required by the WDNR. Material that fails a Level 1 inspection, meaning it is not clean fill, will not be permitted to be used in reclamation activities.

We anticipate the physical effects of sediments on covered fish species and their prey during and immediately following an avulsion event would be similar to those described earlier in this Opinion, although the overall magnitude and duration of those effects will be dependent on the specific characteristics of any particular avulsion event. Fine sediments eroded from the ponds would be transported as an elongated plume downstream (Bakke, pers. comm. 2004). A portion will settle out in back eddies and slack-water zones, to be remobilized during subsequent flows. A portion of these fine sediments may be deposited along an approximate 1.25-mile reach of spawning habitat and infiltrate gravels via hyporheic pathways. The remaining fines would be transported further downstream. Spawning gravels immediately downstream of the Daybreak Mine site will be covered with fine sediments and would remain impacted until hydrologic conditions occur that can mobilize channel bed materials, estimated at a 2 to 4-year return flow event (Bakke, pers. comm. 2004). This contradicts estimates provided in the HCP, but the FWS believes this more accurately represents how sediments will disperse following an avulsion.

Sediment from an avulsion could temporarily affect the abundance of prey species below the Daybreak Mine site to the confluence of the Lewis River. Prey species above the Daybreak Mine site are not expected to be impacted by sediment during an avulsion event. Sediment released during an avulsion is also likely to affect the feeding efficiency of covered fish species as well as exert undue physiological and behavioral stress on covered fish species and their prey as described previously in this document. Most of the sediment derived from gravel processing during years 1 through 3, and sediment placed as part of reclamation activities, will be in Pond 1. Therefore, an avulsion through Pond 1 would have the greatest effect on covered fish species.

Avulsed ponds will initially become somewhat wider and deeper than normal channels (due to differential erosion rates in the finer-textured material), with lower velocities until substantial filling with upstream sediments has occurred. Such impacts are expected to be more pronounced in the years immediately following an avulsion and be ameliorated over time as recovery of the river progresses. CMs undertaken in the HCP will minimize the period of recovery. Rearing coastal cutthroat trout and ammocoetes and juvenile Pacific lamprey and river lamprey are more likely to be affected should the number of predators become more abundant and temperature increase in the avulsed ponds.

Effects on Spawning Habitat (lamprey and prey species)

Approximately 1.25 miles of suitable spawning habitat exists below the Daybreak Mine property. Suitable lamprey spawning habitat in the lower river is generally considered to be located between Dean Creek and Mason Creek. Below RM 6.0 (the zone of tidal influence), spawning habitat is considered poor as the substrate consists largely of mud and sand (WDFW 1951). Sediment released during an avulsion is expected to travel downstream of the Daybreak Mine site with some amount potentially settling out onto this identified suitable spawning habitat. A sediment analysis of the East Fork Lewis River conducted for this project (HCP Technical Appendix C), indicates that sediments would be re-suspended during an avulsion into the existing pits and that the sediment transport capacity of the East Fork Lewis River at the Daybreak Mine site for very fine sand-sized material and greater is fairly large, even for relatively low flows. Regardless, a proportion of the sediments stored in the Daybreak Mine ponds is expected to settle out and be deposited within the 1.25-mile reach containing suitable spawning gravels. In turn, some of this material could infiltrate the interstitial spaces and potentially smother redds or nests causing mortality of some or all of the eggs. In addition, these fine sediment deposits could remain in the interstitial spaces of the spawning gravel until hydrologic conditions occur that can mobilize channel bed materials and transport sediments downstream of the suitable spawning areas, approximately a 2- to 4-year return flow event. Of the species analyzed in this Opinion, Pacific lamprey and river lamprey are the only species expected to spawn below the Daybreak Mine site. Chinook, chum, and steelhead are also known to spawn below the Daybreak Mine site, and impacts to these species could impact the overall prey base of coastal cutthroat trout and bull trout. Since the majority of spawning for these prey species occurs above the Daybreak Mine site, significant reductions in the availability of prey species to the level that would affect the growth rates of either bull trout or coastal cutthroat trout are not expected to occur.

Lamprey have been observed spawning in the reach of the East Fork Lewis River that flows through the Ridgefield Pits, just upstream of the 1.25mile reach of spawning habitat below the Daybreak Mine site (R2 Resources 2000). On other systems, Pacific lamprey have been observed during steelhead spawning surveys and appear to use similar spawning habitat (Jackson *et al.* 1996, Foley 1998). Based on these observations, suitable spawning habitat for lamprey in the East Fork Lewis River mainstem could extend from the end of the tidal influence zone (RM 6.0) to Sunset Falls (RM 31.5). Tributaries in the East Fork Lewis River system would provide additional spawning habitat, as well. At least some, and potentially all, lamprey nests located in the 1.25 miles of suitable spawning below the Daybreak Mine site could be adversely impacted by sediments during an avulsion into the existing pits that coincides with spawning and/or incubation. Spawning for these two species occurs from April to June with the peak occurring in May (Beamish 1980). Incubation can vary slightly among various species of lamprey and can be influenced by water temperature, but generally it lasts between 10 to 20 days. Higher flows, more likely to be associated with an avulsion, occur November through February, outside of the spawning period for lamprey. Therefore, although possible, lamprey nests smothered by sediments as a result of an avulsion into the existing pits would be a rare occurrence. Lamprey nests located above the Daybreak Mine site are not expected to be affected by sediment released during an avulsion into the existing Daybreak Mine pits. Spawning habitat could be negatively affected after an avulsion until excess sediments trapped in the interstitial spaces of gravel are remobilized and transported below river mile 6.0. It is estimated that a 2- to 4-year return flow is sufficient to transport sediment deposited during an avulsion event downstream of the 1.25-mile reach of spawning habitat below the Daybreak Mine site.

Effects of Fish Salvage (post avulsion)

As part of CM-09, should an avulsion occur, Storedahl will assess the potential of take of covered species that may be stranded in isolated or shallow water following an avulsion event, and coordinate efforts with the Services, WDFW, and the LCFRB to return stranded fish to the main channel. Stranding of fish in the existing ponds following an avulsion represents existing, baseline conditions present prior to Storedahl developing a HCP and applying for an ITP. Even though the FWS considers the existing ponds part of the existing baseline conditions at the Daybreak Mine site, certain gravel processing, storm water management, and reclamation activities proposed by Storedahl would alter those existing baseline conditions over the permit term. Though it is difficult to predict or quantify to what extent alterations of the existing ponds may affect fish stranding, as compared to the existing baseline conditions, a CM was developed to salvage fish should they became stranded during an avulsion scenario. Avulsions into the new ponds, although less likely to occur, will garner the same response.

To minimize stranding impacts, Storedahl will work with the Services, WDFW, and LCFRB, to return fish trapped in isolated pools or shallow water to the river by reconnecting these areas to the main channel with heavy equipment and/or employing non-lethal trap and haul methods. Reconnecting the ponds may injury some individuals, but efforts will be coordinated with the Services to minimize this possibility. After discussions with the Services, WDFW, and LCFRB, capture of remaining fish, if warranted and agreed to among the aforementioned parties, will be implemented with nets and seines. No electro-shocking will be permitted. Capture and handling of fish, including bull trout, coastal cutthroat trout, and lamprey may result in the injury or death of some individuals. This could occur primarily from handling stress and/or trauma from nets. Mortality may be immediate or delayed. Injury or death due to handling stress and trauma from nets is believed to be uncommon. Although some of these minimization/mitigation methods have a potential to harm individual fish, salvage operations are expected to increase survival of stranded fish and will be coordinated with the Services, WDFW, LCFRB, and professional fishery biologists contracted by Storedahl to ensure, to the extent practicable, that the majority of the stranded fish will be returned to the river unharmed.

Effects of Head Cutting

Short-term impacts upstream of an avulsion into a gravel mining pond may generally include head cutting (which erodes the bed and increases the channel slope), channel armoring, an increase in the channel armor size (bed coarsening), and lateral instabilities including accelerated bank erosion. When a pond is breached and the elevation of the river is higher than the elevation of the pond, a localized difference occurs in the energy between the higher elevation flow in the river and the lower elevation water in the pond, causing a steep energy gradient to form. The increased energy gradient increases the sediment transport capacity of the river, creating a demand for sediment. If the material forming the armor layer on the channel bed is too small to resist the forces created by the energy imbalance, the channel bed material will erode and be transported downstream. This erosion will then propagate (head cut) upstream until the channel bed has formed a stable slope and armor layer that will resist the forces of the flow. The upstream extent of head cutting is controlled by the size characteristics of the bed sediment, the hydraulics associated with the flow, and the existence of any channel grade controls such as a geologic outcrop or man-made structure.

Long-term upstream impacts may generally include continued head cutting, bed coarsening, channel incision, bank failure due to increased bank heights and slopes caused by the incision, and reduced sediment deposition due to the increased channel slope. During subsequent high flow events, the channel bed may continue to adjust to the changes in hydraulics. Higher flow events may cause additional bed scouring, increasing degradation and coarsening of the bed. The down cutting of the bed could cause an increase in channel bank height and allow channel bed degradation to propagate into the tributaries. All of these processes would be evident as changes in channel cross-section and profile. As the river erodes the banks, an increase in the amount of material input to the stream will occur for the same amount of lateral erosion. This will help satisfy the transport capacity of the river and cause a reduction in the rate of lateral migration. At the same time, excessive bank heights can cause instability and increase the chance of slope failure. The increased slope associated with the head cutting will increase the sediment transport capacity of the river and reduce the amount of material that would otherwise deposit in this reach. Upstream channel incision can also be so great as to affect the stability of hydraulic structures such as levees or bridges by undermining support structures. Eventually, the channel widens to the point where flows become shallower, allowing deposition (aggradation) to occur. Deposition induces meander and floodplain development, and eventually returns bank erosion rates to sustainable levels.

Incision of the river could result in impacts to riparian vegetation because of a lowering of the water table and decreased frequency of overbank flood events. In addition, floodplain function, such as organic matter input to the stream, flooding of side channels, and nutrient exchange between water and floodplain sediments, would be reduced if channel incision over a substantial reach were to occur as a result of avulsion.

When the East Fork Lewis River avulsed into the Ridgefield Pits in 1996, the river changed course and began flowing through a series of six mined and reclaimed gravel ponds. At the entrance to the ponds, the channel bottom degraded by approximately five feet. Later observations by Norman *et al.* (1998) estimated 10 feet of degradation at the entrance. This decrease in bed elevation resulted in the channel bottom head cutting upstream. Although the extent of the migration is unknown, qualitative field observations suggest that head cutting has extended up to at least the Daybreak Bridge. No geologic controls, or active nick points have been identified. It is possible that the original nick point has been dispersed over a distance enough to stabilize it through normal surface armoring processes. No structures appear to have been noticeably undermined as a result of the Ridgefield Pit avulsion event. The historical slide area along the high bank on the south side of the river upstream of the Ridgefield site, however, continues to actively erode. The bluff erosion is likely caused by a combination of deep-seated lateral migration of the channel as a result of channel incision triggered by the avulsion into the Ridgefield Pits. No systematic studies of changes to the river cross section, profile, or substrate characteristics to document the post avulsion channel have been initiated.

Pacific lamprey and river lamprey habitat would be adversely affected as a result of head cutting from an avulsion into the existing ponds. Under baseline conditions, an avulsion scenario is not only more likely to occur, but the upstream effects on covered species, especially Pacific lamprey and river lamprey, are expected to be more severe. Without measures to reclaim the existing ponds with clean fill material, a headcut would travel further upstream and the recovery of this reach of the river would take longer.

Gravel Pits Reclaimed by Filling: Avulsions occur naturally in meandering alluvial rivers under conditions where a foreshortened, erodible floodway exists between two points on the channel. In such cases, the avulsion "short circuits" the flow, causing a longer, less-steep reach segment to be replaced by a steeper, more direct pathway. Generally, the formation of the avulsion channel begins as knick point erosion where turbulent, over-bank floodwaters reenter the channel. The knick point then erodes (head-cuts) back up-gradient until the upstream channel is encountered, completing the short circuit. In the anastomosing channels formerly common to western Washington, avulsions were often initiated when the main channel became blocked by log jams, re-activating an existing secondary channel. In such a case, the new main channel could be of similar or even greater length (and thus similar or lesser slope) than the pre-avulsion main channel, which is important to the discussion that follows.

An avulsion into a shorter, steeper channel segment initiates a cycle of reach-scale channel adjustment, consisting of incision and recovery. Incision (streambed erosion) occurs because the steeper slope provides greater energy, and thus greater ability to mobilize and move sediment. Thus, sediment is transported out faster than it is replenished from upstream. This bed erosion occurs as either as a longitudinally-dispersed erosion zone or a discrete knick point which migrates upstream until a barrier is encountered or until the incision has reduced the slope and the bed surface (armor layer) has coarsened, reducing the sediment transport rate. In a natural avulsion, this distance will generally be one or two times the length of the original abandoned channel.

The channel incision results in accelerated bank erosion rates, due to increased confinement of floodwaters and higher, less stable streambanks. Increased bank erosion begins to widen the incised channel, causing it to shallow and eventually reducing its sediment transport capacity to the point where deposition can begin to occur. This initiates a phase of aggradation (sediment deposition), fed by sediments from upstream bank erosion and continued local lateral migration as the channel re-establishes a more stable meander pattern and profile, and begins to re-establish a hydrologic floodplain. At the same time, toe slope and bank erosion declines to sustainable levels, and over-steepened banks begin to take a more stable form as bank angles decline and vegetation re-establishes a rooting zone and surface cover.

Downstream reaches respond to the increased sediment loads presented to them by aggrading. In a natural channel with a functional hydrologic floodplain, this aggradation can initiate channel adjustments, including pool infilling, surface fining and additional avulsions. However, in most human-occupied settings, some antecedent channel incision is present, reducing the de-stabilizing effects of the sediment pulse.

Full geomorphic recovery from the avulsion requires an approach to equilibrium river morphology. This includes a meander pattern and pool-riffle topography that evens out the energy dissipation rate, a slope and stream bed texture in balance with the sediment transport rates, sustainable bank erosion rates (where erosion is balanced by deposition), and sustainable LWD recruitment, retention and export.

The purpose of CM-08, Mining and Reclamation Designs, is to effectively narrow and shallow the existing ponds, creating a morphology which mimics a natural side channel during an avulsion. In doing this, it is believed that an avulsion occurring into these ponds will behave and recover similarly to a naturally-occurring floodplain avulsion, as described above. It is recognized, however, that the material used to fill the ponds is much finer and more easily mobilized than the natural floodplain substrate. Thus, avulsion into the reclaimed ponds will create an initially wider and deeper pathway than a natural avulsion. A knick point will likely form, but will be substantially less pronounced than in the case of an unfilled pond with a deep bottom. If the avulsion happens after successful establishment of a mature forest on the reclaimed surface, LWD is expected to provide resistance to mobilization of the infill sediments. Finally, it is likely that the length of channel in the avulsion pathway will not be substantially different from that of the abandoned channel, thus reducing the local incision potential.

Existing (Unmodified) Gravel Pits: There are two major differences between the scenario described above and one where there is an avulsion into a deep gravel pit or string of pits having substantial sediment storage volume. The first distinction is that during the avulsion event and for many years after, the pits will act as sediment traps. The second difference is that the upstream migrating knick point will be much more severe in the unmodified gravel pits (i.e. higher and propagating further upstream).

By trapping much of the incoming sediment load, even the "new" sediments mobilized by upstream reach destabilization, the pits cause downstream sediment starvation. With sediment being transported out but little coming in, the downstream bed will tend to incise (erode) and its surface to coarsen. Such incision can have effects on streambank destabilization and increased bank erosion rates similar to what was discussed above for the upstream reach.

In a natural channel avulsion, incision processes establish the "grade" (slope and elevation) of the new channel. By contrast, an avulsion into a deep, wide pond encounters a grade which is defined by the downstream or outlet end of the pond. This hydraulic control becomes the base level to which the upstream channel must adjust. The result is a much higher, more severe knick point, with the net effect of a much more severe and extensive episode of upstream channel incision. If the incision of the downstream reach erodes the outlet of the ponds, lowering their surface level, it is possible to have a second episode of headcutting upstream as well.

There are two additional implications. First, the length of affected upstream reach is less dependent on the length of channel cut off by the avulsion, and more dependent on the volume of the pit below river thalweg (bottom) elevation. Secondly, geomorphic recovery will not substantially proceed until the pit is filled in. This additional first phase of recovery can take many years.

It is illustrative to contrast an avulsion in a natural, multi-thread anastomosing channel such as the pre-historic East Fork Lewis River, with an avulsion of the existing East Fork Lewis River into a string of deep, wide gravel pits. In the natural river, avulsions were largely induced by log jam dynamics. Many avulsions simply re-activated pre-existing side channels. In such cases, the slope or longitudinal profile of the "new" channel was probably very similar to that of the abandoned channel. Thus, river energy dissipation patterns and sediment transport were not severely affected, unless the new channel impinged on a high, erosive terrace. Upstream and downstream incision would be minor. There would be no reach-scale destabilization of bank erosion rates.

With an avulsion of the existing single-thread East Fork Lewis River into a string of deep, wide gravel pits, we expect to observe upstream incision that progresses for several meander wavelengths, depending on the volume of the pits and the height of the initial knick point. Substantial lateral destabilization ensues, requiring years for recovery. Downstream incision, though less severe, also results in lateral instability. Neither upstream nor downstream reaches can approach recovery until sediment influx has filled the pits.

In summary, Pacific lamprey and river lamprey spawning habitat upstream of the Daybreak Mine site would be adversely affected as a result of head cutting from an avulsion into the existing ponds. Under baseline conditions, an avulsion scenario is not only more likely to occur, but the upstream and downstream effects on covered species (especially Pacific lamprey and river lamprey) are expected to be more severe. Without measures to reclaim the existing ponds with clean fill material, a headcut would travel further upstream and the recovery of this river reach would take longer. Sediment starvation of downstream reaches would also result in channel incision and concomitant lateral instability and increased sediment inputs in the absence of the proposed reclamation activities. Even under the HCP, a head cut is expected to be initiated and travel upstream, albeit to a lesser extent when compared to baseline conditions. An estimated 1,582 feet of available Pacific lamprey and river lamprey spawning habitat occurs in the reach that would be affected by a headcut. During an avulsion it is expected that this spawning habitat would be adversely affected by a headcut resulting in a loss of lamprey nests, if present at the time of an avulsion. Additionally, this reach would continue to be unstable during periods of peak flows for approximately 5 years following an avulsion. If these flows correspond with spawning and incubation of lamprey nests, disturbance to the nest could occur once or more during this period. Since lamprey spawn in spring or later, the occurrence of peaks flows would be less likely to occur.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. Several of the more important federal actions occurring in the action area include on-going consultation with the Federal Energy Regulatory Commission on the operation and maintenance of three dams and reservoirs on the Lewis River, the implementation of the Northwest Forest Plan on the Gifford Pinchot National Forest, and the development of a HCP for the recently adopted Washington State Forest Practices Rules and Regulations that were revised to reflect the substance of the Forests and Fish Report (FFR 1999).

Approximately 56 percent of the upper East Fork Lewis River Watershed is owned and managed by private forest products companies for timber production, and the harvest of these forest products is subject to regulations under Washington State Forest Practices Regulations (WDNR 2003). Another 23 percent is owned and managed by the WDNR for timber production consistent with trust land management responsibilities. The remaining forest lands are owned and managed by the United States Forest Service under the Northwest Forest Plan (USDA and USDI 1994). The following discussion addresses non-federal actions reasonably certain to occur in the action area. The action area encompasses the entire 300-acre Daybreak mine site, Dean Creek downstream of J.A. Moore Rd, and the East Fork Lewis River from R.M. 10 (Daybreak Bridge) to its confluence with the Lewis River.

On-going Commercial Forest Management

The FWS anticipates that existing non-federal forest lands in the action area will continue to be cut as they reach harvestable diameters and stocking levels. Existing roads will be maintained to access the forest stands, and some new roads will be constructed to access timber resources. The harvest of timber on non-federal lands in the upper East Fork Lewis River Watershed will be conducted under the rules and regulations of the state's forest practices rules. Currently, and in the past, many of these harvest activities have not been subject to section 7 consultations because of the lack of a federal nexus. Recently, the WDNR has been developing an HCP for an incidental take permit that covers new rules and regulations promulgated from the Forest and Fish Report (FFR 1999). These more restrictive rules are already being implemented under the Washington State Forest Practices rules (WAC 222). If the permit application is approved, incidental take permit coverage would extend to private forest landowners and their harvest activities at the time of permit issuance. Timber harvest will continue at some level on non-federal lands in the East Fork Lewis Watershed. Under these rules, harvest will continue to adversely affect water temperatures in the lower East Fork Lewis River but to a lesser extent as riparian conditions begin to improve. Covered fish species are currently affected by warm water temperatures in the lower East Fork Lewis, and this trend is expected to continue in the future, but impacts due to timber harvest in riparian areas is anticipated to decrease over time as these rules are implemented.

Residential and Commercial Development

Residential and commercial development is expected to continue to occur at a rapid rate. This loss is expected to continue throughout Clark County, along the East Fork Lewis River, and in the action area. Clark County remains one of the fastest growing counties in Washington state and residential development continues to spread in all directions from the City of Vancouver and the I-5 corridor. The total population that resides in the East Fork Lewis River watershed was estimated at 22,443 people in 2001. In 1990, the Office of Financial Management reported Clark County as having 92,849 housing units to serve a population of 238,053 or 2.6 persons per unit. Using a comparable density, the number of dwellings units in the watershed in the year 2000 is estimated at 9,400 units and expected to increase by 12,000 units by the year 2020 (GeoEngineers 2001). For the purpose of this Opinion and the cumulative effects analysis, the projected future expanse of the developed area will be assumed to be the extent of non-federal lands in the action area not already protected by state or local ordinances or not covered by this or any other section 7 consultation. The effects of development to covered species are expected to increase as the size of the developed area increases. New residential and commercial development would be expected to result in an increase in impervious surfaces and contaminated run-off, loss of fish and wildlife habitat, and continued encroachment into riparian areas in the action area at or about the same rate it is expected to occur in Clark County.

Transportation Infrastructure

Transportation infrastructure will continue to keep pace with the growth of residential and commercial development and, as a result, the amount of impervious surfaces will increase. Large, individual transportation projects generally require a number of permits that, in turn, would likely trigger a section 7 consultation. Smaller road projects, such as spur roads or residential access roads that contribute to the amount of impervious surface in the action area, may as individual projects not be subject to section 7 consultations. An increase in roads and road improvements will continue to contribute to the amount of impervious surfaces and facilitate rural residential development in the action area. The adverse effects of new roads and improved roads on covered species are expected to increase as roads become more numerous resulting in the loss or continued degradation of fish and wildlife habitat.

Agriculture and Mining

Agriculture, although unlikely to increase in size as a land-use practice, will remain a dominate land use in the lower East Fork Lewis River Watershed and the action area. Impacts to water quality can continue to be expected from these operations, although implementation of County-approved farm plans will continue to have some positive affect on water quality. Typically, section 7 consultations are not conducted on farm plans. The amount of agricultural lands in the action area is expected to decrease overtime as lands are converted from agricultural uses to residential uses. In the near term, water quality in the East Fork Lewis River will continue to be affected by agriculture adversely affecting covered species as storm water fun-off enters the East Fork Lewis River and its tributaries.

Mining will continue as a land use in the East Fork Lewis River Watershed. Several approved mines on terraces above the East Fork Lewis River currently operate and, for the foreseeable future, will operate in the watershed. No other mines currently exist or are in the planning stages within the action area.

Habitat Restoration and Protection

Significant steps have been taken to preserve existing habitat and to enhance and restore degraded habitat on the lower East Fork Lewis River and the action area. Clark County levies a conservation futures tax which funds the acquisition of open space. Over the past decade, this fund has aided in the purchase of 2,100 acres of floodplain and riparian areas along the East Fork Lewis River. Clark County owns 1,775 acres. Other landowners include the Washington State Parks Department, WDFW, City of LaCenter, and a nonprofit group. Similar land purchases will occur in the future, and these lands will be managed along with previously acquired properties as part of the Lower East Fork Lewis River Habitat and Greenway System (Vancouver-Clark Parks and Recreation 2003). Various groups have also funded and participated in restoration projects on the East Fork Lewis River, and it is anticipated that additional restoration projects will be proposed and implemented on the East Fork Lewis River. These efforts to restore and protect lands adjacent to the East Fork Lewis River within the action area will provide long-term benefits to all covered species. To date, the majority of these lands have been purchased and preserved in the lower East Fork Lewis River (RM 0.5 to RM 14.0).

In conclusion, the FWS expects adverse effects to covered species in the action area from some of the aforementioned activities. Other of the aforementioned activities will have an overall positive effect on covered species in the action area. Cumulatively, the effects are not expected to be significant at the species level or the population level, as the action area represents only a small proportion of the covered species' population or range-wide distributions.

CONCLUSION

Listed Species/Critical Habitat

Bull Trout

After reviewing the current status of the bull trout, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the FWS's Opinion that issuance of a section 10(a)(1)(B) permit for the J.L. Storedahl and Sons, Inc. Daybreak Mine HCP, as proposed, is not likely to jeopardize the continued existence of this species. The Effects of the Action section above fully describes the FWS's rationale for arriving at this conclusion. In summary, implementation of the HCP and issuance of the incidental take permit will not appreciably reduce the likelihood of the survival and recovery of bull trout in the wild for the following reasons: (1) no self-sustaining populations are anticipated to be present in this system; (2) no critical habitat has been designated for bull trout, therefore none will be affected; (3) there is an extremely low likelihood of bull trout occurring in the East Fork Lewis River; (4) the East Fork Lewis River is notably excluded from the Lewis Core Area in the draft bull trout recovery plan (USFWS 2002b); (5) take levels anticipated for bull trout under the plan are expected to be extremely low, based on infrequent and seasonal use the East Fork Lewis River by foraging bull trout; and (6) the premise that the conservation measures committed to in the final HCP, directly or indirectly, minimize and mitigate potential impacts from covered activities to this species. Below is a summary of the components of the proposed HCP that were particularly instrumental in supporting the FWS's conclusion with regard to bull trout:

1. Installation of a closed-loop wash water clarification system (CM-01) and the implementation of a Storm Water and Erosion Control Plan and Storm Water Pollution Control Plan (CM-02) designed to minimize turbidity in water discharged from the Daybreak Mine site from gravel mining and processing activities and storm water run-off.

2. Donation of 330 afy of water rights during May through September to the State Trust, in perpetuity, for the purpose of the enhancement of instream flows in the East Fork Lewis River (CM-03).

3. The creation of a million dollar plus interest endowment to provide for habitat monitoring, site management, and response to an avulsion should one occur (CM-05), once Storedahl has relinquished the 300-acre property in fee title with a conservation easement to one or more conservation-minded group(s) to manage the property, in perpetuity, for fish and wildlife (CM-12).

4. Restoration of 134 acres of mixed conifer and hardwood forests and forested wetlands on the Daybreak Mine site within the 100-year floodplain of the East Fork Lewis River (FEMA 2000) (CM-06).

Other Covered Species – Not Listed as Threatened or Endangered

Coastal Cutthroat Trout

After reviewing the current status of the coastal cutthroat trout, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the FWS's Opinion that issuance of a section 10(a)(1)(B) permit for the J.L. Storedahl and Sons, Inc. Daybreak Mine HCP, as proposed, is not likely to jeopardize the continued existence of this species. The Effects of the Action section above fully describes the FWS's rationale for arriving at this conclusion. In summary, implementation of the HCP and issuance of the ITP will not appreciably reduce the likelihood of the survival and recovery of coastal cutthroat trout in the wild for the following reasons: (1) no suitable spawning habitat for coastal cutthroat trout exists in the East Fork Lewis River below the Daybreak Mine site; (2) coastal cutthroat trout's utilization of the East Fork Lewis River and tributary streams above and the access to tributary streams below the Daybreak Mine site; (3) the poor quality of coastal cutthroat trout spawning habitat in Dean Creek affected by the action; (4) the currently wide-ranging distribution of coastal cutthroat trout; (5) the extremely small portion of the overall range-wide population of coastal cutthroat trout affected by the proposed action; and (6) the premise that the conservation measures committed to in the final HCP, directly or indirectly, minimize and mitigate potential impacts from covered activities to this species. Below is a summary of the components of the proposed HCP that were particularly instrumental in supporting the FWS's conclusion with regard to coastal cutthroat trout:

1. Installation of a closed-loop wash water clarification system (CM-01) and the implementation of a Storm Water and Erosion Control Plan and Storm Water Pollution Control Plan (CM-02) designed to minimize turbidity in water discharged from the Daybreak Mine site from gravel mining and processing activities and storm water run-off.

2. Donation of 330 afy of water rights during May through September to the State Trust, in perpetuity, for the purpose of the enhancement of instream flows in the East Fork Lewis River (CM-03) and the augmentation of summer flows in Dean Creek (CM-04).

3. The creation of a million dollar plus interest endowment to provide for habitat monitoring, site management, and response to an avulsion should one occur (CM-05), once Storedahl has relinquished the 300-acre property in fee title with a conservation easement to one or more conservation-minded group(s) to manage the property, in perpetuity, for fish and wildlife (CM-12).

4. Commitment to provide labor, equipment, and/or materials up to $25,000 per year for 10 years to public and private not-for-profit groups for the enhancement of floodplain functions with in the East Fork Lewis River basin related to the protection and recovery of covered species (CM-11).

5. Establishment of a 200-foot riparian management zone along the portion of Dean Creek that borders Storedahl's property (CM-113) and restoration of in-channel habitat including bank stabilization and the placement of large woody debris at the rate of 1 piece per 72 feet of channel.

6. Restoration of 134 acres of mixed conifer and hardwood forests and forested wetlands on the Daybreak Mine site within the 100-year floodplain of the East Fork Lewis River (FEMA 2000) (CM-06).

7. Commitments to reduce and control non-native predatory fish in the existing Daybreak Mine ponds by the target harvest of these species year 5, 10, and 15 of the HCP, and installation of educational signs informing the public about the dangers to native fish of releasing non-native fish to wetlands and ponds adjacent to streams and rivers.

Pacific Lamprey and River Lamprey

After reviewing the current status of the Pacific lamprey and river lamprey, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the FWS's Opinion that issuance of a section 10(a)(1)(B) permit for the J.L. Storedahl and Sons, Inc. Daybreak Mine HCP, as proposed, is not likely to jeopardize the continued existence of these species. The Effects of the Action section above fully describes the FWS's rationale for arriving at this conclusion. In summary, implementation of the HCP and issuance of the ITP will not appreciably reduce the likelihood of the survival and recovery of Pacific lamprey and river lamprey in the wild for the following reasons: (1) a small amount of suitable spawning habitat (approx. 1.5 miles) for Pacific lamprey and river lamprey exists in the East Fork Lewis River in the vicinity of the Daybreak Mine site; (2) availability of suitable spawning habitat for Pacific lamprey and river lamprey in the East Fork Lewis River mainstem and tributaries that, based on lamprey biology, could extend from the end of the tidal influence zone (RM 6.0) to Sunset Falls (RM 31.5); (3) the poor quality of Pacific lamprey and river lamprey spawning habitat affected by the action; (4) the currently wide-ranging distribution of Pacific lamprey and river lamprey (5) the extremely small portion of the overall range-wide population Pacific lamprey and river lamprey affected by the proposed action; and (6) the premise that the conservation measures committed to in the final HCP, directly or indirectly, minimize and mitigate potential impacts from covered activities to this species. Below is a summary of the components of the proposed HCP that were particularly instrumental in supporting the FWS's conclusion with regard to Pacific lamprey and river lamprey:

1. Installation of a closed-loop wash water clarification system (CM-01) and the implementation of a Storm Water and Erosion Control Plan and Storm Water Pollution Control Plan (CM-02) designed to minimize turbidity in water discharged from the Daybreak Mine site from gravel mining and processing activities and storm water run-off.

2. Donation of 330 afy of water rights during May through September to the State Trust, in perpetuity, for the purpose of the enhancement of instream flows in the East Fork Lewis River (CM-03) and the augmentation of summer flows in Dean Creek.

3. The creation of a million dollar plus interest endowment to provide for habitat monitoring, site management, and response to an avulsion should one occur (CM-05), once Storedahl has relinquished the 300-acre property in fee title with a conservation easement to one or more conservation-minded group(s) to manage the property, in perpetuity, for fish and wildlife (CM-12).

4. Commitment to provide labor, equipment, and/or materials up to $25,000 per year for 10 years to public and private not-for-profit groups for the enhancement of floodplain functions with in the East Fork Lewis River basin related to the protection and recovery of covered species (CM-11).

5. Establishment of a 200-foot riparian management zone along the portion of Dean Creek that borders Storedahl's property (CM-113) and restoration of in-channel habitat including bank stabilization and the placement of LWD at the rate of 1 piece per 72 feet of channel.

6. Restoration of 134 acres of mixed conifer and hardwood forests and forested wetlands on the Daybreak Mine site within the 100-year floodplain of the East Fork Lewis River (FEMA 2000) (CM-06).

7. Commitments to reduce and control non-native predatory fish in the existing Daybreak Mine ponds by the target harvest of these species year 5, 10, and 15 of the HCP, and installation of educational signs informing the public about the dangers to native fish of releasing non-native fish to wetlands and ponds adjacent to streams and rivers (CM-16).

Oregon Spotted Frog (candidate species)

After reviewing the current status of the Oregon spotted frog, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the FWS's Opinion that issuance of a section 10(a)(1)(B) permit for the J.L. Storedahl and Sons, Inc. Daybreak Mine HCP, as proposed, is not likely to jeopardize the continued existence of this species. The Effects of the Action section above fully describes the FWS's rationale for arriving at this conclusion. In summary, implementation of the HCP and issuance of the ITP will not appreciably reduce the likelihood of the survival and recovery of Oregon spotted frog in the wild for the following reasons: (1) no documentation that Oregon spotted frogs currently exist on the Daybreak Mine site or Clark County; (2) take levels anticipated for Oregon spotted frogs under the plan are expected to be extremely low; (3) the poor quality of the potential Oregon spotted frog habitat affected by the action; (4) the commitment of Storedahl to survey the Daybreak Mine site for Oregon spotted frogs should a population of Oregon spotted frogs be documented in Clark County; and (5) the premise that the conservation measures committed to in the final HCP, directly or indirectly, minimize and mitigate potential impacts from covered activities to this species. Below is a summary of the components of the proposed HCP that were particularly instrumental in supporting the FWS's conclusion with regard to Oregon spotted frog:

1. The creation of a million dollar plus interest endowment to provide for habitat monitoring, site management, and response to an avulsion (should one occur) (CM-05), once Storedahl has relinquished the 300-acre property in fee title with a conservation easement to one or more conservation-minded group(s) to manage the preserve and the property, in perpetuity, for fish and wildlife (CM-12).

2. Restoration of 134 acres of mixed conifer and hardwood forest and forested wetlands within the 100-year floodplain (FEMA 2000) and the creation 84 acres of forested wetlands and emergent wetlands as part of site reclamation efforts (CM-06).

3. Installation of exclusion fences to restrict Oregon spotted frogs from entering areas where active mining, processing, and site reclamation activities are taking place. Exclusion fences are only necessary when the presence of Oregon spotted frogs are documented for the county and subsequent searches on the Daybreak Mine site find Oregon spotted frogs (CM-17).

4. Commitments to reduce and control non-native predatory fish in the existing Daybreak Mine ponds by the target harvest of these species year 5, 10, and 15 of the HCP, and installation of educational signs informing the public about the dangers to native fish of releasing non-native fish to wetlands and ponds adjacent to streams and rivers (CM-16).

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the FWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

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

It is noteworthy to mention that 4 of the 5 species addressed in this Opinion are not currently listed or proposed for listing. At the time the ITP is issued, only bull trout will be listed under the Act. Therefore, no take prohibitions will be in place for these four species at the time this Opinion is finalized. The incidental take statements below (and the section 10(a)(1)(B) Permit as it pertains to these unlisted species) do not become effective until (if and when) the currently unlisted species are listed under the Act.

Take Not Covered

It is our policy (per Region 1 memorandum of July 27, 1998) to not consider for inclusion, pesticide and herbicide applications as a covered activity under section 10(a)(1)(B) Permits. The exceptions are those HCPs that address this topic and were submitted to us before July 27, 1998. The subject HCP was submitted to us after 1998. No take is anticipated herein as a result of pesticide or herbicide use in the Plan Area as a result of the proposed action. Pesticide or herbicide use is not a proposed covered activity. No take is authorized for pesticide or herbicide use under the proposed Permit.

Easements and rights-of-way occur or may occur in the future within the perimeter of Storedahl's covered lands and the associated maintenance of such easements are generally performed by parties other than Storedahl. Incidental take resulting from these activities is not covered herein, except for activities undertaken by Storedahl or their agents as specified in the Description of the Action. Examples of activities not covered herein include construction or maintenance of powerlines, associated right-of-way/easement vegetation maintenance (such as clearing of riparian vegetation along a powerline right-of-way), and right-of-way access construction or maintenance. Any take resulting from these activities would be subject to the prohibitions of section 9 of the Act and would need to be authorized or permitted separately through either the section 7 or section 10 process.

Amount or Extent of Take

Bull Trout

We anticipate the take of bull trout to occur as a result of the implementation of the HCP over the 25-year term of the ITP. We anticipate that the incidental take of individual bull trout will be difficult to detect for the following reasons: 1) delayed mortality; 2) rapid rate of fish decomposition; 3) high probability of scavenging by predators; 4) very low densities of bull trout expected to utilize the East Fork Lewis River during the permit term, leading to a low likelihood of finding fish; 5) dead or impaired specimens may be washed downstream of the impact site; and 6) any loss may be masked by seasonal fluctuations in numbers or by other causes. Therefore, even though we expect incidental take of bull trout to occur from the effects of the proposed action, the best scientific and commercial data available are not sufficient to enable us to estimate a specific number of individuals incidentally taken based on the loss or injury of individuals of the species. We do anticipate this number to be extremely low, based on the lack of evidence suggesting foraging bull trout frequently use the East Fork Lewis River, infrequent and seasonal use of the East Fork Lewis River by foraging bull trout, and the conservation measures committed to in the HCP are designed to minimize and mitigate the effects of the proposed project.

Using post project habitat conditions as a surrogate indicator of take, the FWS anticipates that the following forms of incidental take will occur during the 25-year permit term:

1. Take of bull trout in the form of **harm** will occur through the impairment of essential foraging behaviors associated with the direct impacts of elevated sediment levels in the East Fork Lewis River during an avulsion into the Daybreak Mine site. Harm is expected to occur in the East Fork Lewis River downstream of the Daybreak Mine site (RM 8.0) until its confluence with the Lewis River. The life history forms expected to be harmed by elevated sediment levels resulting from an avulsion are fluvial subadult and adult bull trout. The take authorized by the incidental take statement is for all bull trout foraging in the East Fork Lewis River downstream of the Daybreak Mine site (RM 8.0).

2. Take of bull trout in the form of **direct death or injury** will occur as a result of fish handling and salvaging activities following an avulsion event into the Daybreak Mine ponds. Fish salvage operations will actively disturb and may potentially harm individual bull trout, if they are captured. However, fish salvage operations, if necessary, will minimize impacts to stranded fish following an avulsion into the Daybreak Mine ponds and, therefore, minimize the take of individuals. Few bull trout are expected to be captured during fish salvage operations and only a small subset of those individuals is expected to be killed. The take authorized by this incidental take statement is for all bull trout captured during fish salvage operations in the Daybreak Mine ponds following an avulsion of the East Fork Lewis River into the ponds.

Coastal Cutthroat Trout

We anticipate the take of coastal cutthroat trout to occur as a result of the implementation of the HCP over the 25-year term of the ITP. We anticipate that the incidental take of coastal cutthroat trout would be difficult to detect at the individual organism level for the following reasons: 1) delayed mortality; 2) rapid rate of fish decomposition; 3) high probability of scavenging by predators; 4) low densities of coastal cutthroat trout expected to utilize the lower East Fork Lewis River and Dean Creek below J.A. Moore Road during the permit term, leading to a low likelihood of finding fish; 5) dead or impaired specimens may be washed downstream of the impact site, and 6) any loss may be masked by seasonal fluctuations in numbers or by other causes. Therefore, even though we expect incidental take of coastal cutthroat trout to occur from the effects of the proposed action, the best scientific and commercial data available are not sufficient to enable us to estimate a specific number of individuals incidentally taken based on the loss or injury of individuals of the species. We do anticipate this number to be low because of the low density of coastal cutthroat trout expected to utilize the lower East Fork Lewis River, coastal cutthroat trout are not expected to spawn in this section of the East Fork Lewis River, and the conservation measures committed to in the HCP are designed to minimize and mitigate the effects of the proposed project.

Using post project habitat conditions as a surrogate indicator of take, the FWS anticipates that the following forms of incidental take will occur during the 25-year permit term:

1. Take of coastal cutthroat trout in the form of **harassment** will occur through the disruption of normal migrating, spawning, and foraging behaviors associated with the direct impacts of elevated sediment levels in Dean Creek as a result of the mining and processing of gravel on the 300-acre Daybreak Mine site. Harassment is expected to occur in Dean Creek downstream of the J.A. Moore Road. The life history forms expected to be harassed by elevated sediment levels in Dean Creek resulting from gravel mining and processing are juvenile, subadult, and adult coastal cutthroat trout. The take authorized by this incidental take statement is for all coastal cutthroat trout utilizing Dean Creek below J.A. Moore Road until its confluence with the East Fork Lewis River.

2. Take of coastal cutthroat trout in the form of **harm** will occur through the impairment of essential migrating and foraging behaviors associated with the direct impacts of

elevated sediment levels in the East Fork Lewis River as a result of an avulsion into the Daybreak Mine site. Harm is expected to occur in the East Fork Lewis River downstream of the Daybreak Mine site (RM 8.0) until its confluence with the Lewis River. The life history forms expected to be harmed by elevated sediment levels are juvenile, subadult, and adult coastal cutthroat trout. The take authorized by this incidental take statement is for all coastal cutthroat trout migrating through and foraging in the East Fork Lewis River downstream of the Daybreak Mine site to its confluence with the Lewis River.

3. Take of coastal cutthroat trout in the form of **direct death or injury** will occur as a result of entrapment due to flooding and/or fish handling and salvaging activities following an avulsion that connects the East Fork Lewis River to the existing Daybreak Mine ponds. Fish salvage operations will actively disturb individual coastal cutthroat trout, if they are captured. However, fish salvage operations, if necessary, will minimize impacts to stranded fish following an avulsion event that connects the East Fork Lewis River to the ponds. Few coastal cutthroat trout are expected to be capture during fish salvage operations and only a small subset of those individuals is expected to be killed. Coastal cutthroat trout that enter the existing ponds during a flood event and become trapped when water recedes may also be taken due to unfavorable habitat conditions in the existing ponds or in the event of a catastrophic spill of chemical additives used for processing occurs in the existing ponds. The life history forms expected to be taken are juvenile, subadult, and adult coastal cutthroat trout. The take authorized by this incidental take statement is for 1) all coastal cutthroat trout captured during fish salvage operations in the Daybreak Mine ponds following an avulsion, 2) all coastal cutthroat trout trapped in the existing ponds following a flood event with a greater than 17-year return period that temporarily connects the existing ponds to Dean Creek or the East Fork Lewis River, 3) coastal cutthroat trout in the existing ponds that are subject to a catastrophic spill of the chemical additives used for gravel processing, and 4) coastal cutthroat trout redds in Dean Creek downstream of the Pond 5 outlet as a result sediment interacting with the chemical additives and being deposited on spawning gravels in Dean Creek below Pond 5.

Pacific Lamprey and River Lamprey

We anticipate the take of Pacific lamprey and river lamprey to occur as a result of the implementation of the HCP over the 25-year term of the ITP. We anticipate that the incidental take of Pacific lamprey and river lamprey would be difficult to detect at the individual level for the following reasons: 1) delayed mortality; 2) rapid rate of decomposition; 3) high probability of scavenging by predators; 4) low densities of Pacific lamprey and river lamprey expected to utilize the East Fork Lewis River and Dean Creek during the permit term, leading to a low likelihood of finding lamprey; 5) dead or impaired specimens may be washed downstream of the impact site; and 6) any loss may be masked by seasonal fluctuations in numbers or by other causes. Therefore, even though we expect incidental take of Pacific lamprey and river lamprey to occur from the effects of the proposed action, the best scientific and commercial data available are not sufficient to enable us to estimate a specific number of individuals incidentally taken based on the loss or injury of individuals of the species. We do anticipate this number to be low because of the low density of Pacific lamprey and river lamprey expected to utilize the lower East Fork Lewis River and Dean Creek downstream of J.A. Moore Road, the low densities of Pacific lamprey and river lamprey expected to spawn in this section of the East Fork Lewis River, and the conservation measures committed to in the HCP are designed to minimize and mitigate the effects of the proposed project.

Using post project habitat conditions as a surrogate indicator of take, the FWS anticipates that the following forms of incidental take will occur during the 25-year permit term:

1. Take of Pacific lamprey and river lamprey in the form of **harassment** will occur through the impairment of essential migrating, spawning, and feeding behaviors associated with the direct impacts of sediment levels in Dean Creek as a result of the mining and processing of gravel on the 300-acre Daybreak Mine site in Dean Creek downstream of J.A. Moore Road to its confluence with the East Fork Lewis River. The life history forms expected to be harassed by elevated sediment levels resulting from gravel mining and processing are larval, ammocoetes, and adult Pacific lamprey and river lamprey. The take authorized by this incidental take statement is for all Pacific lamprey and river lamprey migrating, feeding, and spawning in Dean Creek below J.A. Moore Road to its confluence with the East Fork Lewis River.

2. Take of Pacific lamprey and river lamprey in the form of **harm** will occur through the impairment of essential migrating, spawning, and feeding behaviors associated with the direct impacts as a result of an avulsion into the Daybreak Mine site. Harm is expected to occur in the East Fork Lewis River downstream of the Daybreak Mine site (RM 8.0) until its confluence with the Lewis River. The life history forms expected to be harmed by elevated sediment levels resulting from an avulsion are larval, ammocoetes, and adult Pacific lamprey and river lamprey. The take authorized by this incidental take statement is for all Pacific lamprey and river lamprey migrating, feeding, and spawning in the East Fork Lewis River downstream of the Daybreak Mine site at the time an avulsion occurs. Lamprey that spawn in the 1.25 mile reach of spawning habitat below the Daybreak Mine site and the 1,582 feet of spawning immediately above the Daybreak Mine site will beharmed during an avulsion scenario that coincides with spawning activities. This spawning habitat will also be significantly impaired by sediment (downstream) or headcut (upstream) for up to five years after an avulsion.

3. Take of Pacific lamprey and river lamprey in the form of **direct death or injury** will occur as a result of entrapment due to flooding and/or fish handling and salvaging activities following an avulsion that connects the East Fork Lewis River to the existing Daybreak Mine ponds. Fish salvage operations will actively disturb individual Pacific lamprey and river lamprey, if they are captured. However, fish salvage operations, if necessary will minimize impacts to stranded Pacific lamprey and river lamprey following an avulsion event that connects the East Fork Lewis River to the ponds. Few Pacific lamprey and river lamprey are expected to be captured during fish salvage operations and only a small subset of those individuals is expected to be killed. Pacific lamprey and river lamprey that enter the existing ponds during a flood event and become trapped when

water recedes may also be taken due to unfavorable habitat conditions in the existing ponds or in the event of a catastrophic spill of chemical additives used for processing occurs in the existing ponds. The life history forms expected to be taken are larval, ammocoetes, and adult Pacific lamprey and river lamprey. The take authorized by this incidental take statement is for 1) all Pacific lamprey and river lamprey captured during fish salvage operations in the Daybreak Mine ponds following an avulsion 2) all Pacific lamprey and river lamprey trapped in the existing ponds following a flood event with a greater than 17-year return period that temporarily connects the existing ponds to Dean Creek or the East Fork Lewis River 3) all Pacific lamprey and river lamprey in the existing ponds that are subject to a catastrophic spill of the chemical additives used for gravel processing and 4) Pacific lamprey and river lamprey nests in Dean Creek downstream of the Pond 5 outlet as a result of sediment interacting with the chemical additives and being deposited on spawning gravels in Dean Creek below Pond 5.

Oregon Spotted Frog (candidate species)

We anticipate that an undetermined number of Oregon spotted frogs would be taken over a 25-year period as a result of the proposed action. Oregon spotted frogs are not known to occur on covered lands and are currently not found in Clark County. Incidental take is anticipated due to impacts associated with gravel mining, gravel process, and site reclamation activities occurring within the 300 acres of Storedahl-owned lands. We anticipate the number of Oregon spotted frogs taken to be extremely low and difficult to detect based on 1) the lack of evidence suggesting Oregon spotted frogs inhabit Clark County; 2) the unlikely scenario that Oregon spotted frogs would colonize the site during active gravel mining and processing; 3) delayed mortality; 4) rapid rate of decomposition; 5) high probability of scavenging by predators; and 6) the premise that the conservation measures committed to in the HCP are designed to minimize and mitigate the effects of the proposed project on Oregon spotted frogs including the creation of 134 acres of emergent and forested wetlands, efforts to remove predatory fish from the existing ponds, and the installation of exclusion fences to avoid direct take of frogs if and when frogs occupy the site.

The incidental take during the 25-year permit term is anticipated to be in the following forms:

1.) Take of Oregon spotted frogs in the form of **harassment** through the disruption of normal breeding, feeding, and sheltering behaviors as the result of the modification and degradation of 0.25 acres of wetland habitat on the 300-acre Daybreak Mine site. All life history forms of Oregon spotted frogs are expected to be harassed by modification and degradation of this habitat. The take authorized by this incidental take statement is for all Oregon spotted frogs associated with 0.25 acres of wetland disturbed by mining excavation expected to occur in approximately year 10 of the 25-year permit term.

2.) Take of Oregon spotted frogs in the form of **harm** through the disruption of normal breeding, feeding, and sheltering behaviors as the result of the modification and degradation of 0.25 acres of wetland habitat on the 300-acre Daybreak Mine site. All life history forms of Oregon spotted frogs are expected to be harmed by modification and degradation of this habitat. The take authorized by this incidental take statement is for all Oregon spotted frogs associated with 0.25 acres of wetland disturbed by mining excavation expected to occur in approximately year 10 of the 25-year permit term.

3.) Take of Oregon spotted frogs in the form of **direct death or injury** could result from frog/truck interactions, predation, and in the event of a catastrophic spill of the chemical agents used in the gravel processing during the first 10 to 15 years. The take authorized by this incidental take statement is for all Oregon spotted frogs on the 300-acre Daybreak Mine site.

EFFECT OF THE TAKE

Listed Species

In the accompanying Opinion, the FWS determined that the level of anticipated take is not likely to result in jeopardy to bull trout. NOAA Fisheries has made the same determination for Chinook salmon, chum salmon, and steelhead in its Opinion for the proposed HCP and related Agreements (NOAA Fisheries 2004).

The FWS believes the levels and forms of incidental take authorized in this Opinion are not likely to jeopardize the continued existence of any currently listed species. Further, the incidental take authorized here-in will not substantially reduce the size, distribution, or productivity of the local, regional or range-wide populations of these species.

Other Covered Species – Not Listed as Threatened or Endangered

In the accompanying Conference Opinion, the FWS determined that this level of anticipated take is not likely to result in jeopardy to any of the currently unlisted, covered species including coastal cutthroat trout, Pacific lamprey, river lamprey, and Oregon spotted frog.

Reasonable and Prudent Measures/Terms and Conditions

The proposed HCP and accompanying Agreements identify anticipated impacts to all Covered Species likely to result from the proposed actions, and the specific measures and levels of species and habitat protection that are necessary and appropriate to minimize those impacts. All of the conservation and management measures in the final HCP with Addendum (Sweet *et al.* 2003) and accompanying Agreements, together with the terms identified in the associated IA, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions for this incidental take statement pursuant to 50 CFR 402.14(I). Such terms and conditions are non-discretionary and must be undertaken by Storedahl for the exemptions under section 10 (a)(1)(B) and section 7 (o)(2) of the Act to apply. If Storedahl fails to adhere to these terms and conditions, the protective coverage of the section 10 (a)(1)(B) permit and section 7 (o)(2) may lapse.

Reporting Requirements

In accordance with 50 CFR 402.14 (i)(3), the HCP and accompanying Agreements specify provisions for monitoring and reporting the effects and effectiveness of the mitigation and minimization measures on the covered species and their habitats. Storedahl will also submit periodic monitoring reports to the FWS, according to the monitoring and reporting schedule contained in the HCP and IA.

CONSERVATION RECOMMENDATIONS

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

1. The FWS should provide technical assistance to Storedahl throughout the term of the ITP described in the HCP and IA;

2. The FWS should conduct regular compliance monitoring inspections and review periodic, scheduled monitoring reports; and

3. The FWS will, at the time of listing of any of the four currently unlisted covered species, reassess the analysis in this Opinion, and determine whether continued implementation of the HCP and Permit would jeopardize the existence of any Covered Species.

RE-INITIATION NOTICE

This concludes formal consultation and conference on implementation of the J.L. Storedahl and Sons, Inc. Daybreak Mine Expansion and Habitat Enhancement Project, Habitat Conservation Plan. As provided in 50 CFR §402.16, re-initiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or, (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

At the time of listing, the FWS is to confirm the conference opinion as a biological opinion issued through formal consultation if any currently unlisted covered species becomes listed. If the FWS reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the FWS will confirm the conference opinion as the biological opinion on the project and no further section 7 consultation will be necessary.

After listing of any currently unlisted covered species, and any subsequent adoption of this conference opinion, Storedahl shall request re-initiation of consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or, (4) a new species is listed or critical habitat designated that may be affected by the action.

The incidental take statement provided in this conference opinion does not become effective until the time any unlisted covered species becomes listed and the conference opinion is adopted as the biological opinion issued through formal consultation. At that time, the project will be reviewed to determine whether any take of any unlisted covered species has occurred. Modifications of the Opinion and incidental take statement may be appropriate to reflect that take. Take of any newly listed covered species must not occur between the listing and adoption of the conference opinion through formal consultation, or the completion of a subsequent formal consultation.

LITERATURE CITED

Alaska Department of Fish and Game. 1963. Investigations of anadromous Dolly Varden populations in the Lake Eva-Hanus Bay drainages, southeastern Alaska. Dingell-Johnson Project Report, 1962-63, Vol. 4.

Allen, T.F.R. and T.B. Star. 1982. Hierarchy: perspectives for ecological complexity. Chicago Univ. Press, Chicago, Illinois.

Armstrong, R.H. 1965. Some migratory habits of the anadromous Dolly Varden *Salvelinus malma* (Walbaum) in southeastern Alaska. Alaska Department of Fish and Game. Research Report No. 3. Juneau, Alaska. 36 p.

Bakke, P. 2004. Draft analysis of comments: Daybreak Mine Expansion and Habitat Enhancement Project. Paul bake, Hydrologist/Geomorphologist, U.S. Fish and Wildlife Service, Lacey, Washington.

Barton, D.R., W.D. Taylor, and R.M. Biette. 1985. Dimensions of riparian buffers strips required to maintain trout habitat in southern Ontario. North American Journal of Fisheries Management 5, 364-378.

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

Baxter, C.V., and F.R. Hauer. 2000. Geomorphology, hyporheic exchange, and the selection of spawning habitat by bull trout *(Salvelinus confluentus)*. Canadian Journal of Fisheries and Aquatic Science. 57: 1470-1481.

Baxter, J.S., and J.D. McPhail. 1997. Diel microhabitat preferences of juvenile bull trout in an artificial stream channel. North American Journal of Fisheries Management 17:975-980.

Bayer, J.M., T.C. Robinsón, and J.G. Seelye. 2000. Upstream migration of Pacific lampreys in the John Day River, behavior, timing, and habitat use. Annual Report 2000, Report to the Bonneville Power Administration, Contact No. 2000A126080, Project No. 200005200. 47 p.

Bayer, J.M., M.H. Meeuwig, and J.G. Seelye. 2001. Identification of larval Pacific, river, and western brook lamprey and thermal requirements of early life stages of lampreys. Annual Report for Bonneville Power Administration, Portland, Oregon. Project No. 2000-029.

Beamish, R.J. 1980. Adult biology of the river lamprey (*Lampetra ayresi*) and the Pacific lamprey (*Lampetra tridentata*) from the Pacific coast of Canada. Canadian Journal of Fisheries and Aquatic Science. 37 (11):1906-1923.

Beamish, R.J., and Youson, J.H. 1987. Life history and abundance of young adult *Lampetra ayresi* in the Fraser River and their possible impact on salmon and herring stocks in the Strait of Georgia. Canadian Journal of Fisheries and Aquatic Science. 44 (3):525-537.

Beamish, R.J., and Neville, C.E.M. 1995. Pacific salmon and Pacific herring mortalities in the Fraser River plume caused by river lamprey (*Lampetra ayresi*). Canadian Journal of Fisheries and Aquatic Science. 52 (3):644-650.

Behnke R. J. 1992. Native trout western North America. American Fisheries Society Monograph 6. Bethesda, Maryland.

Behnke R. J. 1997. Evolution, systematics, and structure of *Oncorhynchus clarki clarki* in J.D. Hall, B.A. Bisson, and R.E. Gresswell (eds.), Sea-run cutthroat trout: biology, management, and future conservation. P. 3-6. Oregon Chapter, Am. Fish. Soc., Corvallis, Oregon.

Behnke, R.J. and M. Zarn. 1976. Biology and management of threatened and endangered western trout. U.S. Forest Service Gen. Tech. Rep. RM-28, 45p.

Bell, M.C. 1986. Fisheries handbook of engineering requirements and biological criteria. U.S. Army Corps of Engineers, Fish Passage and Development and Evaluation Program, Portland, Oregon.

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 Sciences. 42: 1410-1417.

Bestchta, R.L., W.S., R.E. Boyle, C.C. Chambers, W.P. Gibson, S.V. McComb, M.L. Reiter, G.H. Taylor, and J.E. Warila. 1995. Cumulative effects of forest practices in Oregon. Oregon State University, Oregon Department of Forestry, Salem, Oregon.

BioAnalysts, Inc. 2000. A status of Pacific lamprey in the mid-Columbia region. Prepared for Public Utility District No. 1 of Chelan County, Wenatchee, Washington. Boise, Idaho.

Bisson, P.A., R.E. Bilby, M.D. Bryant, C.A. Dolloff, G.B. Grette, R.A. House, M.L. Murphy, K.V. Koski and J.R. Sedell. 1987. Large woody debris in forested streams in the Pacific Northwest: past, present, and future. *In* Streamside management: forestry and fishery interactions. E.O. Salo and T.W. Cundy, Editors, University of Washington, Institute of Forest Resources:143-190.

Birtwell, Ian K. 1999. The Effects of Sediment on Fish and Their Habitat. Canadian Stock Assessment Secretariat Research Document 99/139.

Bjornn, T.C., M.A. Brusven, M.P. Molnau, J.H. Milligan, R.A. Klamt, E. Chacho, and C. Schaye. 1977. Transport of granitic sediment in streams and its effects on insects and fish. University of Idaho, Idaho Cooperative Fisheries Research Unit, Completion Report, Project B-036-IDA, Bulletin 17. Moscow, Idaho.

Bjornn, T.C. and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 *in* W.R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. Special Publication 19, American Fisheries Society, Bethesda, Maryland.

Blaustein, A.R., J.J. Beatty, D.H. Olson, and R.M. Storm. 1995. The biology of amphibians and reptiles in old-growth forests in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-337. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon. 98 p.

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

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

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

Boulton, A.J., S. Findlay, P. Marmonier, E.H. Stanley, and M. Valett. 1998. The functional significance of the hyporheic zone in streams and rivers. Annu. Rev. Ecol. Syst. 29, 59-81.

Boyer, R., and C.E. Grue. 1995. The need for water quality criteria for frogs. Environmental Health Perspectives. 103:352.

Brewin, P.A., and M. K. Brewin. 1997. Distribution Maps for Bull Trout in Alberta. Pages 206-216 *in:* Mackay, W.C., M.K. Brewin and M. Monita, (eds). Friends of the Bull Trout Conference Proceedings. Bull Trout Task Force (Alberta), c/o Trout Unlimited Calgary, Alberta, Canada.

Brown, L.G. 1992. On the zoogeography and life history of Washington native char Dolly Varden (*Salvelinus malma*) and bull trout (*Salvelinus confluentus*). Washington Department of Wildlife, Fisheries Management Division Report. Olympia, Washington.

Brunke, M. and T. Gosner. 1997. The ecological significance of exchange processes between rivers and groundwater. Freshwater Biology, 37 1-33.

Bryant, M.D. 1983. The role and management of woody debris in West Coast salmonid nursery streams. North American Journal of Fisheries Management 3:322-330.

Buchanan, D. M. and S. V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. Pages 1-8 *in*: Mackay, W.C., M.K. Brewin and M. Monita, (eds). Friends of the Bull Trout Conference Proceedings. Bull Trout Task Force (Alberta), c/o Trout Unlimited Calgary, Alberta, Canada.

Castro, J., and Reckendorf, F. 1995. RCA III: effects of sediment on the aquatic environment; potential NRCS actions to improve aquatic habitat. Natural Resources Conservation Service, Oregon State University, Department of Geosciences.

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

Chapman, D.W. 1988. Critical Review of Variable Used to Define Effects of Fines in Redds of Large Salmonids. Transactions of the American Fisheries Society. 117:1-21.

Clancy, C.G. 1993. Statewide Fisheries Investigations, Bitterroot Forest Inventory. Helena, Montana: Montana Department of Fish, Wildlife, and Parks, Fisheries Division. [not paged]. Job Completion Report. Project F-46-R-4. (As referenced in U.S. Department of Interior 1998d).

Close, D.A., Fitzpatrick, M., Li, H., Parker, B., and Hatch, D. 1995. Status report of the Pacific lamprey (*Lampetra tridentata*) in the Columbia River Basin. Prepared for the U.S. Department of Energy, Bonneville Power Administration. Project Number 94-026. 35 p.

Cochran, P.A. 1986. Attachment sites of parasitic lampreys: Comparisons among species. Environ. Biol. Fish. 17 (1):71-80.

Collins, B. 1997. IX. Application of the geomorphology to planning assessment of riverine gravel removal in Washington. Geology and Geomorphology of Stream channels, University of Washington, Seattle, Washington. January 14 and 15, 1997.

Connor, E., D. Reiser, K. Binkley, D. Paige, and K. Lynch. 1997. Abundance and distribution of an unexploited bull trout population in the Cedar River Watershed, Washington. Pages 403-411 *in:* Mackay, W.C., M.K. Brewin, and M. Monita, (eds). Friends of the bull trout conference proceedings. Bull Trout Task Force (Alberta), c/o Trout Unlimited, Calgary, Alberta, Canada.

Cook, F.R. 1984. Introduction to Canadian amphibians and reptiles. National Museum of Natural Science, National Museum of Canada.

Corkran, C. and C. Thoms. 1996. Amphibians of Oregon, Washington, and British Columbia. Lone Pine Publishing, Renton, Washington.

Craig and Wissmar. 1993. *In:* USDI (United States Department of Interior). 1997. Endangered and threatened wildlife and plants; proposal to list the Klamath River population segment of bull trout as an endangered species and Columbia River population segment of bull trout as a threatened species. U.S. Fish and Wildlife Service. June 13, 1997. Federal Register 62(114):32268-32284.

DeCicco, A.L. 1992. Long-distance movements of anadromous Dolly Varden between Alaska and the U.S.S.R. Arctic 45(2):120-123.

Dolloff, C.A. 1986. Effects of stream cleaning on juvenile coho salmon and Dolly Varden in southeast Alaska. Transactions of the American Fisheries Society 115: 743-755.

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

Dunham, J. B. and B.E. Rieman. 1999. Metapopulation structure of bull trout: influences of physical, biotic, and geometrical landscape characteristics. Ecological Applications, 9(2), 1999, pp 642-655.

Dunham, J.B. and G.L. Chandler. 2001. Models to predict suitable habitat for juvenile bull trout in Washington state. Final report to U.S. Fish and Wildlife Service, Lacey, Washington.

Dunham, J., B. Rieman, and G. Chandler. 2001. Development of field-based models of suitable thermal regimes for Interior Colombia Basin salmonids. Interagency agreement #00-IA-11222014-521. Final report to EPA, Seattle Washington.

Dunlap, D.G. 1955. Inter- and intraspecific variation in Oregon frogs of the genus *(Rana)*. American Midland Naturalist 54:314–331.

Dunne, T. and L.B. Leopold. Water in water planning. W.H. Freeman and Company, New York, New York.

Elle, S. 1995. Rapid River bull trout movements and mortality. Annual performance report 95-03, Idaho Fish and Game, Nampa, Idaho.

Elliott, S.T. 1986. Reduction of a Dolly Varden population and macrobenthos after removal of logging debris. Transactions of the American Fisheries Society 115:392-400.

Ecological Land Services. 1998. Wetland delineation report, Daybreak Mine, Clark County, Washington. Prepared for J.L. Storedahl and Sons Inc., Kelso, Washington, Longview, Washington

Engler, J., and D.C. Friesz. 1998. Draft 1998 Oregon spotted frog breeding surveys, Conboy Lake National Wildlife Refuge, Klickitat County, Washington. Unpublished Report. 5 p.

Everest, F.H., N.B. Armantrout, S.M. Kellner, W.D. Parante, J.R. Sedell, T.E. Nickelson, J.M. Johnson, and G.N. Haugen. 1985. Salmonids. Pages 199-230 *in:* E.R. Brown, editor. Management of fish and wildlife habitats in forests of western Oregon and Washington. Publication r6-f&WL-192-1985. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Portland, Oregon.

Faler, M.P. and T.B. Bair. 1996. Distribution, migrating patterns, and habitat characterization of adfluvial bull trout in tributaries to the North Fork Lewis River. Wind River Ranger District, Carson, Washington.

Fraley, J.J. and B.B. Shepard. 1989. Life history, ecology and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and River system, Montana. Northwest Science 63(4):133-143.

Federal Emergency Management Agency (FEMA). 2000. National Flood Insurance Program, Floodway, Flood Boundary and Flood Maps, Clark County, Washington. Community-Panel Numbers 5300024-159, 178-179, 186. July 19, 2000.

FFR. 1999. Forest and Fish Report presented to the Forest Practices Board and the Governor's Salmon Recovery Office on February 22, 1999. 87 pp. with appendices.

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

GEO Engineers. 2001. Level 1 Technical Assessment Water Resource Inventory Areas 27 and 28. Prepared for the Lower Columbia Fish Recovery Board. File No. 8491-0001-00-1180.

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

Goetz, F. 1994. Distribution and juvenile ecology of bull trout (*Salvelinus confluentus*) in the Cascade Mountains. Master's Thesis. Oregon State University, Corvallis, Oregon.

Golden, J.T. 1975. Lethal temperatures for coastal cutthroat trout under fluctuating temperature regimes. Oregon Department of Fish and Wildlife Report, Unpublished Manuscript, ODFW, P.O. Box 59, Portland, Oregon.

Graham, P. J., Shepard, B. B., and Fraley, J. J. 1981. Use of stream habitat classifications to identify bull trout spawning areas in streams. Pages 186-190 *in* N. B. Armantrout. Acquisition and utilization of aquatic habitat inventory information. American Fisheries Society. Portland, Oregon.

Green, D.M., H. Kaiser, T.F. Sharbel, J. Kearsley, and K.R. McAllister. 1997. Cryptic species of spotted frogs, (*Rana pretiosa)* complex in western North America. Copeia 1997:1–8.

Graves, S.K. 1979. Merwin, Yale, and Swift Reservoir study: 1978-1979. Washington Department of Game. Unpublished report. 43 p.

Graves, S.K. 1983. Merwin, Yale, and Swift Reservoir study: 1978-1982. Washington Department of Game. Unpublished report. 103 p.

Hard, J. 1995. A quantitative genetic perspective on the conservation of intraspecific diversity. American Fisheries Society Symposium 17:304-326.

Hardisty, M.W., and I.C. Potter (eds.). 1971. The biology of lampreys. Vol. 1. Academic Press, New York.

Hart, J.L. 1973. Pacific fishes of Canada. Bull. Fish. Res. Board Can. 180. 740 p.

Hayadhi, M. and D.O. Rosenberry. 2002. Effects of ground water exchange on hydrology and ecology of surface water. Groundwater Vol 40, No. 2.

Hayes, M.P. 1994. The spotted frog (*Rana pretiosa*) in western Oregon. Part I. Background. Part II. Current status. Oregon Department of Fish and Wildlife Technical Report 94–1–01.

Hayes, M.P. 1997. Status of Oregon spotted frog (*Rana pretiosa sensu stricto*) in the Deschutes Basin and selected other systems in Oregon and northeastern California with rangewide synopsis of the species' status. Final report prepared for The Nature Conservancy under contract to the U.S. Fish and Wildlife Service, 2600 SE 98th Ave., Suite 100, Portland, Oregon, 97266. 57 p. plus appendices.

Hayes, M.P. 1998a. The Buck Lake Oregon spotted frog (*Rana pretiosa*) population (Spencer Creek System, Klamath County, Oregon). Final report prepared for the Bureau of Land Management and The Nature Conservancy under contract to Winema National Forest. Unpublished Report. 22 p.

Hayes, M.P. 1998b. The Wood River Oregon spotted frog (*Rana pretiosa*) population (Klamath County, Oregon). Final report prepared for the Bureau of Land Management. Unpublished Report. 20 p.

Hayes, M.P. 1998c. The Buck Lake Oregon spotted frog (*Rana pretiosa*) population (Spencer Creek System, Klamath County, Oregon). Final report prepared for the Bureau of Land Management and The Nature Conservancy under contract to Winema National Forest. Unpublished Report. 22 p.

Hayes, M.P. and M.R. Jennings. 1986. Decline of ranid frog species in western North America: are bullfrogs (*Rana castesbeiana*) responsible? J. Herpet. 20(4):490-509.

Healy, M.C. and A. Prince. 1995. Scales of variation in life history tactics of Pacific salmon and the conservation of phenotype and genotype. American Fisheries Society Symposium 17:176-184.

Hillman, T.W., J.S. Griffith, and W.S. Platts. 1987. Summer and winter habitat selection by juvenile Chinook salmon in a highly sedimented Idaho stream. Transactions of the American Fisheries Society 116:185-195.

House, R.A., and P.L. Boehne. 1987. The effect of stream cleaning on salmonid habitat and populations in a coastal Oregon drainage. Western Journal of Applied Forestry 2:84-87.

Huggenburger, P., E. Hoehn, R. Beschta, and W. Woessner. 1998. Abiotic aspects of channels and floodplain in riparian ecology. Freshwater Biology 40 pp 407-425.

Hunter, J.W. 1973. A discussion of game fish in the State of Washington as related to water requirements. Washington Department of Game, Olympia, Washington.

Hutton, R. 1995a. East Fork Lewis River water quality assessment background report. Clark County Department of Community Development. Clark County, Washington.

Hutton, R. 1995b. East Fork Lewis River watershed characterization background report. Clark County Department of Community Development. Clark County, Washington.

Jakober, M. 1995. Autumn and winter movement and habitat use of resident bull trout and westslope cutthroat trout in Montana. M.S. Thesis, Montana State University, Bozeman, Montana.

Johnson, O.W., M. H. Ruckelshaus, W. S. Grant, F.W. Waknitz, A.M. Garrett, G.J. Bryant, K. Neely, and J.J. Hard. 1999. Status review of coastal cutthroat trout from Washington, Oregon, and California. Northwest Fisheries Science Center, National Marine Fisheries Service, Seattle, Washington. 320 p.

Johnston, J.M. 1982. Life histories of anadromous cutthroat with emphasis on migratory behavior. *In:* E.L. Brannon and E.O. Salo (eds.). Proceedings of the salmon and trout migratory behavior symposium, p. 123-127. University of. Washington, Seattle, Washington.

Johnston, J.M. 1979. Sea-run cutthroat Stillaguamish River creel census (1978) and harvest recommendations. Washington Department of Game and Fish. Res. Report, Olympia, Washington. 43 p.

Jones, J.B. and P.J. Mulholland. 2000. Streams and ground waters. Academic Press, San Diego, California.

Kasahara, T. and S. M. Wondzell. 2003. Geomorphic controls on hyporheic exchange flow in mountain streams. Water Resources Research, Vol. 39(1) pp. 3-1 to 3-14.

KCDNR (King County Department of Natural Resources). 2000. Literature Review and Recommended Sampling Protocol for Bull Trout in King County. Seattle, Washington. May 2000.

Klarin, P.N., K.M. Branch, M.J. Hershman and T.F. Grant. 1990. An analytical review of state and federal coastal management Systems and Policy Responses to Sea Level Rise. Report to Washington State Department of Ecology, Olympia, Washington.

Kraemer, C. 1994. Some observations on the life history and behavior of the native char, Dolly Varden (*Salvelinus malma*) and bull trout (*Salvelinus confluentus*) of the North Puget Sound Region. Washington Department of Wildlife. Draft.

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

Leary, R. F., F. W. Allendorf, and S.H. Forbes. 1993. Conservation genetics of bull trout in the Columbia and Klamath River drainages. Conservation Biology 7(4): 856-865.

Lisle, T.E. 1986. Effects of woody debris on anadromous salmonid habitat, Prince of Whales Island, Southeast Alaska. North American Journal of Fisheries Management 6:538-550.

Licht, L.E. 1971. Breeding habits and embryonic thermal requirements of the frogs *Rana aurora aurora* and *Rana pretiosa pretiosa* in the Pacific Northwest. Ecology 52:116–124.

Lloyd, D.S., J.P. Koenings, and J.D. LaPerriere. 1987. Effects of turbidity in fresh waters of Alaska. North American Journal of Fisheries Management 7:18-33.

Lohr, S., S. Duke, T. Cummings, and W. Fredenberg. 2001. Listing of Bull Trout as Threatened Species in the United States and Initial Steps in Recovery Planning. *In:* Berwin, M.K., A.J. Paul, and M. Monita. 2001. Bull Trout II Conference Proceedings. 199-205.

MacDonald, A. and K.W. Ritland. 1989. Sediment Dynamics in Type 4 and 5 Waters, A Review and Synthesis. Timber Fish and Wildlife. TFW-012-89-002.

MBTSG (Montana Bull Trout Scientific Group). 1998. The relationship between land management activities and habitat requirements of bull trout. Report prepared for the Montana Bull Trout Restoration Team, Helena, Montana.

McAllister, K.R. 1995. Distribution of amphibians and reptiles in Washington state. Northwest Fauna 3:81-112.

McAllister, K.R., and W.P. Leonard. 1997. Washington state status report for the Oregon spotted frog. Washington Department of Fish and Wildlife. Olympia, Washington. 38 p.

McAllister, K.R., W. Leonard, and R.M. Storm. 1993. Spotted frog (*Rana pretiosa*) surveys in the Puget Trough of Washington 1989-1991. Northwest Naturalist 74:10-15.

McCullough, D.A. 1999. A review and synthesis of effects of alterations to the water temperature regime on freshwater life stages of salmonids, with emphasis to chinook salmon. EPA 910-R-99-010. Prepared for the USEPA, Region 10, Seattle, Washington. 279. http://www.critfc.org/tech/EPAreport.pdf

McCullough, D.A., S. Spalding, D. Sturdevant, and M. Hicks. 2001. Summary of technical literature examining the physiological effects of temperature on salmonids. Issue paper 5. Prepared as part of the EPA Region 10 water quality criteria guidance development project. Seattle, Washington.

McFarland, W.D. and D.S. Morgan. 1996. Description of the ground water flow system in the Portland basin, Oregon and Washington. USGS Water Supply Paper. 2470-A.

McMahon, F., A. Zale, J. Selong, and R. Barrows. 2001. Growth and survival temperature criteria for bull trout. Annual report 2000 (year three). National Council for Air and Stream Improvement. 34 p.

McPhail, J.D. and C. Murray. 1979. The early life history of Dolly Varden *(Salvelinus malma)* in the upper Arrow Lakes. Report to the British Columbia Hydro and Power Authority and Kootenay Department of Fish and Wildlife. University of British Columbia, Department of Zoology and Institute of Animal Resources, Vancouver, Canada. (As referenced in USDI, 1997).

McPhail J.D. and J.S. Baxter 1996. A review of bull trout (*Salvelinus confluentus*) life history and habitat use in relation to compensation and improvement opportunities. Fisheries Management Report No. 104. University of British Columbia, Vancouver, Canada.

Michael, J.H., Jr. 1980. Repeat spawning of Pacific lamprey. California Fish and Game. 66 (3):186-187.

Michael, J.H., Jr. 1984. Additional notes on the repeat spawning by Pacific lamprey. California Fish and Game. 70 (3).

Mongillo, P. E. 1993. The distribution and status of bull trout/Dolly Varden in Washington state. Washington Department of Wildlife. Fisheries Management Division, Report 93-22. Olympia, Washington. 45 p.

Morrow, J.E. 1976. The freshwater fishes of Alaska. Alaska Northwest Publishing Company, Anchorage, Alaska.

Moyle, P.B. 1976. Inland fishes of California. University of California Press, Berkeley, California. 405 p.

Murphy, M.L., J. Heifetz, S.W. Johnson, K.V. Koski and J.F. Thedinga. 1986. Effects of clear-cut logging with and without buffer strips on juvenile salmonids in Alaskan streams. Canadian Journal of Fisheries and Aquatic Sciences. 43:1521-1533.

Murphy, M.L. 1995. Forestry impacts on freshwater habitat of anadromous salmonids in the Pacific Northwest and Alaska–requirements for protection and restoration. NOAA Coastal Ocean Program Decision Analysis Series Number 7. NOAA Coastal Office, Silver Spring, Maryland. 156 p.

Nelson, M., T. McMahon, and R. Thurow. 2002. Decline of the migratory form in bull charr, (*Salvelinus confluentus)*, and implications for conservation. Environmental Biology of Fishes, 64:321-332, 2002.

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

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

Nightingale, B., and C. A. Simenstad. 2001. Overwater structures: marine issues. White Paper, Res. Proj. T1803, Task 35, Washington State Department of Transportation, Washington State Trans. Center (TRAC), Seattle, Washington. 133 p + appendices.

Norman, D.K. 1998. Reclamation of floodplain sand and gravel pits as off-channel habitat. Washington Geology, 26(3).

Norman, D.K., C.J. Cedarholm, W.S. Lingley, Jr. 1998. Flood plains, salmon habitat, and sand and gravel mining. Washington Geology, 26(3).

Nussbaum, R.A., E.D. Brodie, and R.M. Storm. 1983. Amphibians and reptiles of the Northwest. University of Idaho Press, Moscow, Idaho. 332 p.

Oregon Department of Fish and Wildlife. 1996. Species at risk; sensitive, threatened and endangered vertebrates of Oregon. Second Edition, June 1996. Oregon Department of Fish and Wildlife, Wildlife Diversity Program, Portland, Oregon.

OWRRI (Oregon Water Resources Research Institute). 1995. Gravel disturbance impacts on salmon habitat and stream health. Volume II: technical background report. Prepared by OWRRI for Oregon Division of State Lands, Salem, Oregon.

Pearcy, W.G. 1997. The sea-run and the sea. Pages 29-34 *in* J.D. Hall, P.A. Bisson, and R.E. Gresswell, (eds). Sea-run cuthroat trout biology, management, and future conservation. Oregon Chapter American Fisheries Society, Corvalis, Oregon.

Pearl, C. 1999. The Oregon spotted frog (*Rana pretiosa*) in the Three Sisters Wilderness Area/Willamette National Forest. 1998 summary of findings. Unpublished report prepared for the U.S. Fish and Wildlife Service. 20 p.

Pearl, C. and R.B. Bury. 2000. The Oregon spotted frog (*Rana pretiosa*) in the Three Sisters Wilderness Area, Oregon: 1999 findings. Unpublished report prepared for the U.S. Fish and Wildlife Service, Portland, Oregon. 14 p.

Pleyte, Kay A., Shan D. Duncan, and Ruth B. Phillips. 1992. Evolutionary relationships of the salmonid fish genus (*Salvelinus)* inferred from DNA sequences of the first internal transcribed spacer (ITS 1) of ribosomal DNA. Molecular Phylogenetics and Evolution, 1(3):223-230.

Poole, G.C. and C.H. Berman. 2001. An ecological perspective on in-stream temperature: natural heat dynamics and mechanisms of human caused thermal degradation.

Power, G., R.S. Brown, J.G. Imhof. Groundwater and fish–Insights from North America. Hydrological Processes 13, 401-422.

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

Pratt, K.L. and J.E. Huston. 1993. Status of bull trout (*Salvelinus confluentus*) in Lake Pend Oreille and the lower Clark Fork River: (draft report) Prepared for the WWPC, Spokane, Washington.

PSWQAT (Puget Sound Water Quality Action Team). 2000. 2000 Puget Sound Update: Seventh Report of the Puget Sound Ambient Monitoring Program. Puget Sound Water Quality Action Team. Olympia, Washington. Literature References.

Quigley, T.M. and S.J. Arbelbide, tech. editors. 1997. An assessment of ecosystem components in the interior Columbia basin and portions of the Klamath and Great Basins: volume III. General Technical Report PNW-GTR-405. U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management.

Quinault Indian Nation. 1995. Unpublished char seining data.

R2 Resource Consultants Inc. 2000. Field trip completion report East Fork Lewis River, Ridgefield Pits. R2 Resource Consultants Inc, Redmond, Washington.

Redding, JM., C.B. Screak, and F.H. Everest. 1987. Physiological effects on coho salmon and steelhead of exposure to suspended solids. Transactions of the American Fisheries Society. 116:737-744.

Resources Planning Associates and Howe Consultants. 1999. Polymer-assisted clarification of stormwater from constriction sites. Prepared for the City of Redmond, Washington. 30 p. plus appendices.

Richards, J.E., and Beamish, F.W.H. 1981. Initiation of Feeding and Salinity Tolerance in the Pacific Lamprey (*Lampetra tridentata*). Marine Biology. 63 (1):73-77.

Riehle, M., W. Weber, A.M. Stuart, S.L. Thiesfeld and D.E. Ratliff. 1997. Progress report of the multi-agency study of bull trout in the Metolius River system, Oregon. *In*: Friends of the Bull Trout Conference Proceedings, May 5-7, 1994. W.C. MacKay, M.D. Brewin, M. Monita, Co-editors. The Bull Trout Task Force. Calgary, Alberta, Canada. Pages 137-144.

Rieman, B.E. and F.W. Allendorf. 2001. Effective population size and genetic conservation criteria for bull trout. North American Journal of Fisheries Management 21:756-764.

Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. US Forest Service, Intermountain Research Station. General Technical Report INT-302.

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

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

Rieman, B.E., D.C. Lee and R.F. Thurow. 1997. Distribution, status and likely future trends of bull trout within the Columbia River and Klamath Basins. North American Journal of Fisheries Management 17(4):1111-1125.

Renaud, C.B. 1997. Conservation status of Northern Hemisphere lampreys (Petromyzontidae). Journal of Applied Ichthyology. 13 (3):143-148.

Rhodes, J.J., D.A. McCullough and F.A. Espinosa, Jr. 1994. A coarse screening process for potential application in ESA consultations. Columbia River Intertribal Fish Commission. Prepared under NMFS/BIA inter-agency agreement. 40ABNF3.

Rode, M. 1990. Bull trout, *(Salvelinus confluentus)* (Suckley), in the McCloud River: status and recovery recommendations. Administrative Report Number 90-15. California Department of Fish and Game, Sacramento, California.

Roffe, T.J., and Mate, B.R. 1984. Abundances and feeding habits of pinnipeds in the Rogue River, Oregon. Journal of Wildlife Management. 48 (4):1262-1274.

Ruiz-Campos, G., and Gonzalez-Guzman, S. 1996. First freshwater record of Pacific lamprey, *(Lampetra tridentata)*, from Baja California, Mexico. California Fish and Game. 82 (6):144-146.

Russell, J.E., Beamish, F.W.H., and Beamish, R.J. 1987. Lentic spawning by the Pacific lamprey, *(Lampetra tridentata)*. Canadian Journal of Fisheries and Aquatic Science. 44 (2):476-478.

Sabo, J.L. 1995. Competion between stream-dwelling cutthroat trout (*Oncorhyncus clarki clarki*) and coho salmon (*O. kisutch*): implications for community structure and evolutionary ecology. Master's Thesis. University of Washington, Seattle, Washington.

Scott, W.B., and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board. Canada. Bulletin. 14.

Sexauer, H. M. and P. W. James. 1993. A survey of the habitat use by juvenile and pre-spawning adult bull trout, *Salvelinus confluentus*, in four streams in the Wenatchee National Forest. Ellensburg, Washington, Central Washington University.

Schill, D.J. 1992. River and stream investigations. Job Performance Report, Project F-73-R-13. Idaho Department of Fish and Game, Boise, Idaho.

Schill, D., R. Thurow, P. Kline. 1994. Season movements and spawning mortality of fluvial bull trout in Rapid River, Idaho. Job performance report 94-13. Idaho Fish and Game, Nampa, Idaho.

Shepard, B., S.A. Leathe, T.M. Weaver, and M.D. Enk. 1984. Monitoring levels of fine sediment within tributaries to Flathead Lake, and impacts of fine sediment on bull trout recruitment. Proceedings of the Wild Trout III Symposium. Yellowstone National Park, Wyoming. On file at: Montana Department of Fish Wildlife, and Parks, Kalispell, Montana.

Sigler, J.W., T.C. Bjornn, and F.H. Everest. 1984. Effects of chronic turbidity on density and growth of steelheads and coho salmon. Transactions of the American Fisheries Society 113:142-150.

Smith, H.A. and P.A. Slaney. 1979. Age, growth, survival and habitat of anadromous Dolly Varden (*Salvelinus malma*) in the Keogh River, British Columbia. British Columbia Ministry of Environment. Fisheries Management Report. Vancouver, Canada. 56 p.

Spence, B. C., G. A. Lomnicky, R. M. Hughs, and R. P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, Oregon. (Available from the National Marine Fisheries Service, Portland, Oregon).

Stanford, J.A., and J.V. Ward. 1988. The hyporheic habitat of river ecosystems. Nature 335:64-66.

Stanford, J.A. and J.V. Ward. 1993. An ecosystem perspective of alluvial rivers: connectivity and the hyporheic corridor. Journal of North America Benthol. Soc. 12:48-60.

Stanford, J.A., J.V. Ward, and B.K. Ellis. 1994. Ecology of the alluvial aquifers of the Flathead River, Montana, *in:* J. Gilbert, D.L. Danielopol, and J.A. Stanford. (eds). Ground Water Ecology, Academic, San Diego, California.

Stewart, D. 1981. Salmon, herring lost to an ancient predator. West. Fish. 102(6): 44-47.

Stolz, J. and J. Schnell. 1991. Trout. Harrisburg, Pennsylvania. Stackpole Books.

Swanberg, T. 1997. Movements of and habitat use by fluvial bull trout in the Blackfoot River, Montana. Transactions of the American Fisheries Society. 126:735-746.

Sweet, H.R. 2003. Email from Frank W. Barvenik, PH. D. to H. Randy Sweet discussing the toxicity and chronic effects of flocculants and coagulants.

Sweet, H.R, R2 Resource Consultants, Inc., IT Corporation, Ecological Land Services, Maul, Foster, and Alongi, Inc, Janice Kelly, Inc., and Perkins Coie, LLP. 2003. J.L. Storedahl and Sons, Daybreak Mine Expansion and Habitat Enhancement Project, Habitat Conservation Plan and Appendices, Clark County, Washington.

Taylor Associates. 2001. Annual Report for 10(a)(1)(A) take permit (TE-03300-0). January 19, 2001.

Thom, R.M. 1992. Accretion rates of low intertidal salt marshes in the Pacific Northwest. Wetlands 12:147-156.

Thomas, G. 1992. Status of bull trout in Montana. Report prepared for Montana Department of Fish, Wildlife and Parks, Helena, Montana.

Thorpe, J.E. 1994. Salmonid Fishes and the Estuarine Environment. Estuaries. 17 (1A): 76-93.

Trotter, P.C. 1989. Coastal cutthroat trout: life history and compendium. Transactions of American Fisheries Society. 118:463-773.

Trotter, P.C. 1997. Sea-run cutthroat trout: life history profile. *In:* J.D. Hall, P.A. Bisson, and R.E. Gresswell, (eds). Sea-run cutthroat trout biology, management, and future, conservation, proceedings of a symposium. American Fisheries Society. Corvallis, Oregon.

USDI (United States Department of Interior). 1997. Endangered and threatened wildlife and plants; proposal to list the Klamath River population segment of bull trout as an endangered species and Columbia River population segment of bull trout as a threatened species. U.S. Fish and Wildlife Service. June 13, 1997. Federal Register 62(114):32268-32284.

USDI (United States Department of Interior). 1998a. Candidate and listing priority assignment form: bull trout in the Klamath River and Columbia River Bull Trout Population Segments.

USDI (United States Department of Interior). 1998b. A framework to assist in making Endangered Species Act determinations of effects for individuals or grouped actions at the bull trout subpopulation watershed scale. 43 p.

USDI (United States Department of Interior). 1998c . Reinitiation of intra-Service biological opinion on the addition of the Columbia River distinct population segment of bull trout to incidental take permit (PRT-808398) for Plum Creek Timber Company (FWS Reference: 1-3-98-FR-0357; X-Reference: 1-3-96-FW-0190) in accordance with the unlisted species provisions of the implementation agreement for all vertebrate species. U.S. Fish and Wildlife Service. Western Washington Office, Lacey, Washington. July 13, 1998.

USDI (United States Department of Interior). 1998d. Bull Trout Interim Conservation Guidance. U.S. Fish and Wildlife Service. Western Washington Office, Lacey, Washington. December 9, 1998.

USDI (United States Department of Interior). 1999. Endangered and threatened wildlife and plants; determination of threatened status for bull trout in the coterminous United States; final rule. Notice of intent to prepare a proposed special rule pursuant to section 4(d) of the Endangered Species Act for the bull trout; proposed rule. U.S. Fish and Wildlife Service. November 1, 1999. Federal Register Vol. 64:58910.

USDI (United States Department of Interior). 2002. Biological opinion, following reinitiation of consultation for the proposed amendment of the incidental take permit (PRT-777837) for West Fork Timber Company (FWS Reference: 1-3-93-FW-15), to include Canada lynx (*Lynx canadensis*) and the Puget Sound/Coastal bull trout (*Salvelinus confluentus*), Lewis County, Washington.

U.S. Environmental Protection Agency (EPA). 2000. Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates. Second edition. Office of Research and Development, Mid-Continent Ecology Division, U.S. EPA, Duluth, Minnesota.

U.S. Environmental Protection Agency (EPA). 2001. Issue Paper 5: Summary of Technical Literature examining the Physiological Effects of Temperature on Salmonids, Prepared as part of EPA Region 10 Temperature and Water Quality Criteria Guidance Development Project. EPA-910-D-01-005.

U.S. Environmental Protection Agency (EPA). 2003. *EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards*. EPA 910-b-03-002. Region 10 Office of Water, Seattle, Washington.

USFWS (U.S. Fish and Wildlife Service). 1998. Bull trout interim conservation guidance. Lacey, Washington. 47 p.

USFWS (U.S. Fish and Wildlife Service). 2000. Bull trout occurrence and habitat selection. Western Washington Fish and Wildlife Office, Lacey, Washington. October 23, 2000.

USFWS (U.S. Fish and Wildlife Service). 2002a. Bull trout (*Salvelinus confluentus*) draft recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. 137 p.

USFWS (U.S. Fish and Wildlife Service). 2002b. Chapter 20, Lower Columbia Recovery Unit, Washington 89 p. *In:* U.S. Fish and Wildlife Service. Bull trout (*Salvelinus confluentus*) draft recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. 137 p.

USFWS and NOAA Fisheries. 2003. Final Environmental Impact Statement and Response to Comments for the Proposed Issuing of a Multi Species Incidental Take Permit for the Daybreak Mine Expansion and Habitat Enhancement Project proposed by J.L. Storedahl and Sons, Inc. November 2003.

U.S. Forest Service. 1995. Upper East Fork Lewis River watershed analysis, Gifford Pinchot National Forest.

Vannote, R.L., G.W. Minshall, K.W. Cummins, J.R. Sedell, and C.E. Cushing. 1980. The river continuum concept. Canadian Journal of Fisheries and Aquatic Science. 37:130-137.

Volk, E.C. 2000. Using otolith strontium to infer migratory histories of bull trout and Dolly Varden from several Washington state rivers. Submitted to Olympic National Park in fulfillment of Contract # 2550041. Washington Department of Fish and Wildlife, Olympia, Washington.

Wallace, R.L. and K.W. Ball. 1978. Landlocked parasitic Pacific lamprey on Dworshak Reservoir, Idaho. Copeia 3:545-546.

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

Watson, J.W., K.R. McAllister, D.J. Pierce, and A. Alvarado. 1998. Movements, habitat selection, and population characteristics of a remnant population of Oregon spotted frogs (*Rana pretiosa*). Annual Progress Report. Washington Department of Fish and Wildlife. 19 p.

WDFW (Washington Department of Fish and Wildlife). 1951. Lower Columbia River fisheries development program, Grays River Area, Washington. Prepared by the State of Washington Department of Fisheries in collaboration with Fish and Wildlife Service, USDI.

WDFW (Washington Department of Fish and Wildlife). 1994. Draft management recommendations for Washington's priority habitats and species. Unpublished Report, Washington Department of Fish and Wildlife, Olympia, Washington.

WDFW (Washington Department of Fish and Wildlife). 1997. Washington Department of Fish and Wildlife hatcheries program. Operations program - Lewis river complex for January 1, 1997 to December 31,1997. Washington Department of Fish and Wildlife, Olympia, Washington.

WDFW (Washington Department of Fish and Wildlife). 1998. Washington state salmonid stock draft inventory: bull trout/Dolly Varden. Washington Department of Fish and Wildlife, Olympia, Washington.

WDFW (Washington Department of Fish and Wildlife). 2000. Washington state salmonid stock draft inventory: coastal cutthroat trout. http://wdfw.wa.gov/fish/sassi/cutthroat.htm Washington Department of Fish and Wildlife, Olympia, Washington.

Washington Department of Ecology (Ecology). 2001. Ecology's final 1998 list of impaired and threatened waterbodies–the 303(d) list. Available on the internet at www.ecywa.gov.programs/wq/303d

Weaver, T. M. 1992. Status of the adfluvial bull trout populations in Montana's Flathead drainage: the good, the bad, and the unknown. P. 449 *In*: Mackay, W. C., M. K. Brewin, M. Monita (eds). Friends of the bull trout conference proceedings. Bull Trout Task Force (Alberta), c/o Trout Unlimited Calgary, Alberta, Canada.

Weaver, T.M. and R.G. White. 1985. Coal Creek Fisheries monitoring study No. III. Quarterly progress report. U.S. Forest Service, Montana State Cooperative Fisheries Research Unit, Bozeman, Montana.

White, D.S. 1993. Perspective on defining and delineating hyporheic zones. Journal of North America Benthol. Soc. 12:61-69.

Whyte, J.N.C., Beamish, R.J., Ginther, N.G., and Neville, C.E. 1993. Nutritional condition of the Pacific lamprey (*Lampetra tridentata*) deprived of food for periods of up to two years. Canadian Journal of Fisheries and Aquatic Science. 50 (3):591-599.

Wydoski, R.S., and R.R. Whitney. 1979. Inland fishes of Washington. University of Washington Press, Seattle, Washington. 220 p.

Wyman, K. H. 1975. Two unfished salmonid populations in Lake Chester Morse. M.S. Thesis, University of Washington. Seattle, Washington.

Young, R.J. and R.M. Kelso. 1990. Occurrence, relative abundance, and size of landlocked sea lamprey (*Petromyzon marinus*) ammocoetes in relation to stream characteristics in the Great lakes. Canadian Journal of Fisheries and Aquatic Science. 47:1773-1778.

Yousen, J.H., J.A. Holmes, J.A. Guchardi, J.G. Seelye, R.E. Beaver, J.E. Germehl, S.A. Sower and F.W.H. Beamish. 1993. Importance of condition factors and the influence of water temperatures and photoperiod on metamorphosis of sea lamprey, (*Petromyzon marinus*). Canadian Journal of Fisheries and Aquatic Science. 50:2448-2456.