APPENDIX I, Agency Coordination Documents and Public Review Comments and Responses

Additional Water Storage Project, Final Feasibility Study Report & Final EIS

Howard Hanson Dam,
Green River, Washington
August 1998

prepared by
Seattle District
US Army Corps of Engineers

Tacoma Public Utilities

US Army Corps of Engineers®

APPENDIX I
AGENCY COORDINATION DOCUMENTS AND PUBLIC COMMENTS AND RESPONSES

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GARY LOCKE
Governor

STATE OF WASHINGTON
OFFICE OF THE GOVERNOR
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December 19, 1997

Colonel James M. Rigsby
District Engineer
Corps of Engineers
Post Office Box 3755
Seattle, Washington 98124-2255

Dear Colonel Rigsby:

I am writing to express my support for the Howard Hanson Dam Additional Water Storage Project. I believe the feasibility study process and final project address both environmental and regional municipal water needs in a balanced and creative manner. After reviewing this project, I believe the process used for this proposal could serve as a model for this state on how to make regional fish and municipal water decisions.

Let me note here that my continued support for the Howard Hanson project is contingent upon the completion of the National Environmental Policy Act review and the implementation of the adaptive management measures outlined in the October proposal. These approaches are desirable, in my view, because they offer flexibility and allow for adjustments as new information becomes available.

This project appears to have struck the right balance between our natural resources and the public's use of them. For those reasons, I look forward to working with the City of Tacoma, the Corps of Engineers, and other federal and state agencies in securing appropriate funding and permit approval for Phase I of the Howard Hanson Dam Additional Water Storage Project as currently defined. I believe this project represents an opportunity to create one of this region's largest fish and wildlife restoration efforts while providing clean and safe water to residents throughout the Puget Sound Region.

Sincerely,

Gary Locke

Gary Locke
Governor

cc: John Daniels, Jr., Council Chair, Muckleshoot Indian Tribe
Bern Shanks, Director, Department of Fish and Wildlife
Michael J. Spear, Regional Director, U.S. Fish and Wildlife Service
Will Stelle, Regional Administrator, National Marine Fisheries Service

Fym → file

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

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DIRECTOR OF UTILITIE
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November 19, 1997

F/NW

Mark Crisson, Director
Tacoma Public Utility
P.O. Box 11007
Tacoma, Washington 98411

Colonel James M. Rigsby
U.S. Army Corps of Engineers
Post Office Box 3755
Seattle, Washington 98124-3755

Dear Mr. Crisson and Colonel Rigsby:

As requested by the Tacoma Public Utilities' (TPU) letter of October 28, 1997, I am pleased to offer the National Marine Fisheries Service (NMFS) support for the approval and funding of Phase One of the Howard Hanson Additional Water Storage Project (AWSP) as outlined in the October 28, 1997 project description.

The AWSP has water supply goals and ecosystem restoration goals. It will store up to 20,000 ac.ft. of water from Tacoma's undeveloped second diversion water right. The project will also provide a downstream fish passage facility at the dam; the potential for restored salmon and steelhead populations in the upper watershed; habitat improvement; storage of water for fishery purposes; and a number of fishery amenities provided through a Tacoma agreement with the Muckleshoot Indian Tribe (MIT).

The City of Tacoma and the U.S. Army Corps of Engineers (Corps) have worked extensively over the past 7 years with federal and state agencies, MIT, and sports fishers on the feasibility studies associated with the AWSP. I appreciate your flexible and forthright manner in seeking common solutions. You have given an extraordinary effort to design project provisions to accommodate fishery conservation. Your willingness to change operational philosophies and strategies to favor fish demonstrate commitment to the public resource and leadership in the industry.

As you are aware, however, our support must be conditional at this time. It is contingent upon completion of National Environmental Policy Act review, satisfactory resolution of potential issues under the Endangered Species Act (ESA), and resolution of other outstanding issues identified cooperatively by the parties involved in this process.

In particular, the NMFS is responsible for implementing the ESA with regard to anadromous fish. The Green River chinook, which occurs downstream from the current project, may be listed as threatened or endangered under the ESA. A proposed federal project that may affect a listed species or its critical habitat is subject to consultation with NMFS under section 7 of the ESA, 16 U.S.C. § 1536, and actions by both federal and nonfederal entities are subject to the "take"

PUB 12/5/97, Water, Legal

prohibition of section 9, 16 U.S.C. § 1538. I understand that Tacoma will apply for an Incidental Take Permit (ITP) under section 10(a)(1)(B) of the ESA, 16 U.S.C. § 1539(a)(1)(B). To obtain an ITP, an applicant must develop a Habitat Conservation Plan (HCP) that meets the permit issuance criteria of section 10(a)(2), 16 U.S.C. § 1539(a)(2). I understand that Tacoma has committed to incorporating the following principles in the HCP, and the Corps has also committed to following these principles in the AWSP:

1) A clear commitment that Howard Hanson Dam refill and storage management will be dedicated and directed to fishery resource conservation and enhancement.

2) Continuous project operation during refill and storage management periods.

3) A state-of-the-art snow pack monitoring and runoff forecasting system.

4) Effective procedures for risk sharing between municipal supply and fishery resource needs, including use of municipal storage to meet fish needs, when storage flexibilities are not adequate.

5) Funding for, and implementation of, a fishery resource and flow monitoring program, and using results to effectively modify project procedures and design.

6) Restoration of fish habitat where appropriate and where significant benefits can be demonstrated.

Our ultimate support for the project will depend upon an agreement that meets permit issuance criteria and provides for satisfactory implementation of these principles.

My agency stands ready to provide information and assistance during your plan development. I look forward to working with both your organizations in the first phase development of the Howard Hanson Additional Water Storage Project.

Sincerely,

William Stelle, Jr.
Regional Administrator

cc: USFWS - D. Frederick
WDFW - B. Shanks, K. Terwilleger
Governor's Office - C. Smitch
Muckleshoot Indian Tribe - J. Daniels, Jr.
Trout Unlimited - F. Urabeck

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

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DIRECTOR OF UTILITIES
C: Water

November 12, 1997

Mark Crisson
Director, Tacoma Public Utilities
3628 South 35th Street
P.O. Box 11007
Tacoma, WA 98411-0007

Dear Mr. Crisson:

For the last 7 years the City of Tacoma and the Corps of Engineers have done numerous studies in pursuit of additional water supply from Howard Hanson Dam. The Department of Ecology has been active in helping design and comment on these studies. Since your feasibility study is near completion, you are looking for agency support to begin the engineering and design phase for the Howard Hanson Dam Additional Water Storage Project. We understand that our agency's support is necessary for the Corps of Engineers and Tacoma to secure federal and City funding for Phase 1 of this project.

The Department of Ecology supports the approval and funding of Phase 1 of the Howard Hanson Additional Water Storage project as described in your October 28, 1997 proposal. This support is contingent upon satisfactory completion of the National Environmental Policy Act review.

This project will serve two goals: 1) an ecosystem restoration goal to provide net positive resource benefits for Green River wild and hatchery salmon and steelhead, and 2) a water supply goal to provide a cost-effective and sufficient municipal and industrial water supply.

The ecosystem restoration involves a $34 million fish passage facility to allow downstream passage of salmonid fry and juveniles with a trap and haul facility for upstream passage of adults. Tacoma agrees to accept higher minimum instream flows than required by Ecology. The Corps will use adaptive management to restore fish and wildlife habitat affected by reservoir refill operation such as side channels and provide 5000 acre-feet of water for fisheries purposes each year. Additional water will be available for fish through Corps storage management and Tacoma's non-use of their first diversion water in low-flow situations.

Tacoma's water supply will be increased by storing up to 20,000 acre-feet in Howard Hanson Reservoir between February 15 and May 31. The water would be from Tacoma's second diversion water rights using 100 cfs from the Green River conditioned with minimum instream flows even higher than Ecology's existing minimum flows.

Ecology agrees to make the necessary adjustments to Tacoma's second diversion water right to allow storage of the water behind Howard Hanson Reservoir with higher minimum instream flow conditions. In addition, we agree to evaluate Phase 2 of the additional storage project if it becomes feasible.

Sincerely,

Tom Fitzsimmons
Director

United States Department of the Interior

FISH AND WILDLIFE SERVICE
North Pacific Coast Ecoregion
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November 13, 1997

Colonel James M Rigsby
District Engineer
Seattle District, Corps of Engineers
Seattle, Washington 98124-2255

Re: Howard Hanson Additional Water Storage Project

Dear Colonel Rigsby:

The purpose of this letter is to state our support for the Corps of Engineers (Corps) and the City of Tacoma pursuing approval and funding for Phase One of the proposed Additional Water Storage Project (AWSP). For many years, the U.S. Fish and Wildlife Service (Service) has taken a strong interest in this project because of its potential effect on the fish and wildlife resources of the Green River Basin. In particular, we believe this project offers the most feasible means for restoring anadromous fish runs to the 100+ miles of historically used habitat located above Howard Hanson Dam and Reservoir. The project, as described in the Corps' and Tacoma's October 28, 1997 proposal, contains elements that the Service strongly supports, including fish passage facilities, habitat restoration, adaptive management provisions to address uncertainties, and operational modifications that would provide better protection for flows and the dependent fishery resources.

For the above reasons, we believe the AWSP has the potential to result in significant benefits for fish and wildlife. Important details are still under development and formal commitments have yet to be made. We are hopeful that the development of the project's specific details, involving both physical and operational features, continue to meet our expectations. As you should expect, our continued support for Phase One of the AWSP is contingent on the satisfactory development of project details during the National Environmental Policy Act review process.

My staff and I appreciate the efforts the Corps and the City of Tacoma have made in refining the project design to address our concerns. We look forward to working with you toward the development of a project that substantially meets the objectives and goals of all parties.

Sincerely,

David C. Frederick
Supervisor

gg/jmc
DOD/DA/CE/SEA/Howard Hanson AWSP

[An original letter sent to Mark Crisson, Tacoma Public Utilities]

c: NMFS, Lacey (Robert Turner)
WDFW, Olympia (Bern Shanks)
Muckleshoot Indian Tribe, Auburn (John Daniels, Jr.)

State of Washington
DEPARTMENT OF FISH AND WILDLIFE
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Main Office Location: Natural Resources Building • 1111 Washington Street SE • Olympia, WA

November 17, 1997

Mr. Mark Crisson, Director
Tacoma Public Utilities
Post Office Box 11007
Tacoma, Washington 98411-0007

Colonel James M. Rigsby
U.S. Army Corps of Engineers
Post Office Box 3755
Seattle, Washington 98124-3755

Dear Mr. Crisson and Colonel Rigsby:

Tacoma Public Utilities' (TPU) October 28 letter requested our support for the proposed Howard Hanson Dam Additional Water Storage Project (AWSP). The major feature of this proposal is storage of up to 20,000 acre-feet of water from Tacoma's presently undeveloped second diversion water right. TPU and the U.S. Army Corps of Engineers propose additional features including construction of new outlet works for Howard Hanson Dam incorporating downstream fish passage facilities, habitat improvements above and below the dam, and the annual storage of an additional 5,000 acre-feet of water for steelhead incubation protection and other fisheries purposes. These elements would be implemented in combination with other features provided for in a 1995 agreement between TPU and the Muckleshoot Tribe, including construction of upstream fish passage facilities at the TPU diversion dam.

Together these passage facilities are expected to enable substantial restoration of salmon and steelhead to the upper Green River watershed above these dams. Reestablishment of anadromous fish to the upper Green River watershed has been our goal for many years. This is a historic opportunity and we are pleased to endorse moving forward with this effort through the next phase of engineering and design. However, as I am sure you appreciate, our endorsement at this time cannot be unconditional. Our support of the AWSP must be qualified in regard to potential actions under the Endangered Species Act (ESA), fulfillment of our responsibilities under the National Environmental Policy Act (NEPA), and successful completion of the issue resolution process in which we are now engaged.

Our goals in regard to the Green River in general, and the Howard Hanson project in particular, are to achieve maximum net resource benefits, including opportunities for harvest, for all fishery resources. These include steelhead, chinook, coho, and chum salmon. As stated in our letter of February 29, 1996, an essential aspect of the project from our perspective is protection and enhancement of downstream fish production, along with restoration of salmon and steelhead to the upper watershed and full mitigation for impacts to wildlife. Protection of downstream resources is also relevant to possible actions under the ESA, such as the potential listing of Green

River chinook. Fulfillment of our goal in this regard requires resolution of existing deficiencies including impacts associated with storage and diversion of the second supply water right. A central feature of means to accomplish this end is the proposed substantial expansion of flexibility in project refill and storage management, along with a major new emphasis on resource protection. To be successful, these new flexibilities require sweeping change in both existing hardware and current project operating policy. Significant progress has been made, especially over the last few weeks, and we believe these issues will be addressed based on implementation of the principles below.

As you know, there are problems with the existing project that result in persistent and substantial resource losses. Existing summer conservation pool capabilities and operating rules favor fall spawning salmon at the expense of spring spawning wild steelhead. Additional losses arise from other sources including project operations to achieve objectives in conflict with resource needs, uncertainties in runoff forecasting, staffing, and outlet control limitations. We must be certain these do not persist or carry over to the AWSP. Successful resolution of these issues, as well as additional concerns associated with the proposed project, depends to a high degree on dedication of project operation to resource needs. Therefore, our ultimate approval of the project will be based on further detailed agreement(s) that can be achieved as we further refine the project in the coming months.

In summary, realization of the resource benefit potential of the AWSP is absolutely dependant on commitment to and effective implementation of the following principles:

1) clear commitment that Howard Hanson Dam refill and storage management will be dedicated and directed to fishery resource conservation and enhancement;

2) provide for continuous project operation during refill and storage management periods;

3) state-of-the-art enhancement of snow pack monitoring and runoff forecasting;

4) effective procedures for risk sharing between municipal supply and fishery resource needs, including use of municipal storage to meet fish needs when storage flexibilities are not adequate;

5) fund and implement monitoring and use results to effectively modify project procedures and design; and

6) restore fish habitats where appropriate and where significant benefits can be demonstrated.

I wish to express my appreciation for the hard work you have done to formulate a project to meet regional water supply needs and restore salmon and steelhead to the upper Green River watershed above the TPU water diversion and Howard Hanson Dam. This is a formidable challenge. Our mutual efforts over the past years and especially the last few weeks have been fruitful. We look forward to continuing to work with you to complete the formulation of a project that truly fulfills these objectives.

Sincerely,

Bern Shanks, Ph.D.
Director

KT:GE:slt

cc: John Daniels, Jr., Muckleshoot Tribe
Curt Smitch, Governor's Office
David Frederick, U.S. Fish and Wildlife Service
Will Stelle, National Marine Fisheries Service
Frank Urabeck, Trout Unlimited

TROUT UNLIMITED

South King County Chapter
P.O. Box 3434
Federal Way, WA 98003

September 14, 1997

Col. James M. Rigsby
District Engineer
Seattle District
U.S. Army Corps of Engineers
P.O. Box 3755
Seattle, Washington 98124-2255

Dear Col. Rigsby:

The purpose of this letter is to advise you, in advance of the September 19 Alternatives Formulation Briefing, of our continued strong support for the Howard Hanson Dam additional water storage project, as presented in your July 1997 draft Feasibility Report/EIS.

South King County Chapter of Trout Unlimited (TU) has been a long-term partner with the Seattle District Corps of Engineers, Tacoma Public Utilities (TPU), Washington Department of Fish and Wildlife (WDFW) and the Muckleshoot Indian Tribe (MIT) in Green River wild steelhead and salmon preservation and restoration activities. We have participated in the additional storage feasibility study since its inception.

The TU promoted, but cooperatively undertaken, wild steelhead restoration project for the upper Green River watershed began in 1982 when the first wild steelhead fry were planted above Hanson Dam. The fry were produced by the MIT from wild steelhead brood stock captured by the chapter and the Green River Trout Club under WDFW supervision. Currently, around 80,000 fry are released annually in the upper watershed in late August or early September.

Surviving smolts exit through the existing outlet facilities about a year and half later. Because passage through the Corps project is problematic, the effectiveness of our wild steelhead restoration project has been limited. However, we have had as many as 130 adult wild steelhead return to the TU trap at the TPU water supply headworks (barrier to upstream fish migration) which is located 3.5 miles below Hanson Dam.

Obviously, we want to have the Hanson Dam fish passage improvements that would be provided by the increased storage project. The sooner the project goes forward the sooner the public will gain the benefits of upper river natural steelhead and salmon production.

TU believes the additional storage project has been well-formulated with unusually extensive and meaningful agency, tribal, public and scientific community input. The adaptive management strategy gives us confidence that likely unanticipated circumstances will be adequately and successfully addressed. The two phased approach provides further risk management opportunities.

Our membership believes that the risk to salmonids of negative project impacts will be further minimized through continued good planning and additional engineering and biological studies, including appropriate physical modeling of the fish passage facilities. However, we feel that any remaining risk should be borne by the project sponsor rather than the fish. Our expectations and basis for our support is that the project will result in a significant net gain for Green River wild steelhead and salmon production -- below and above Hanson Dam.

The multi-interest public involvement process that your office has developed over the last five years gives us considerable confidence that the Corps and Tacoma will do the right thing for fish. We expect this process to continue and pledge our chapter's support and timely input.

Frank Urabeck will be representing our chapter at the September 19 briefing. Please distribute copies of this letter to others attending the briefing.

Sincerely,

Joseph Madrano, President
South King County
Trout Unlimited

cc: Bill Robinson
Bob Johnson
Frank Urabeck
Bern Shanks

Agency Resolution Letters

State of Washington
DEPARTMENT OF FISH AND WILDLIFE

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Main Office Location: Natural Resources Building • 1111 Washington Street SE • Olympia, WA

February 29, 1996

Colonel Donald T. Wynn
District Engineer
Seattle District, Corps of Engineer
Post Office Box 3755
Seattle, Washington 98124-2255

Mark Crisson
Director
Tacoma Public Utilities
Post Office Box 11007
Tacoma, Washington 98411-0007

Dear Colonel Wynn and Mr. Crisson:

For the past few years, Washington Department of Fish and Wildlife (WDFW) has been working with the Corps of Engineers, Tacoma Public Utilities, the Muckleshoot Indian Tribe, and other natural resource agencies to make improvements at Howard Hanson Dam. These include enhancing the fish and wildlife populations at the project vicinity and in the Green River both above and below the project, as well as making modifications to the dam for improved fish passage. In the past three months, staff has attended many meetings and shared written documents back and forth with the Corps of Engineers and Tacoma staff.

At the February 9 meeting, the latest draft proposal was presented. I stated WDFW's support of the first phase (through pre-construction, engineering, and design phase) of the Howard Hanson Dam Additional Water Storage Project as outlined in your February 9, 1996, proposal. This letter serves to reiterate that expression of support and is in anticipation of the Corps and Tacoma meeting the conditions of the proposal, our review of the project feasibility report, and our review of the Environmental Impact Statement.

Favorable progress has been made on identifying and resolving issues of concern. Key issues (e.g., the potential conflict between storage and outmigrant survival through and below the project) remain and may not be resolved until additional information is gathered. The proposal includes the establishment of a technical team to attempt to resolve these issues. Greater refinement is also needed in specific performance criteria, a monitoring program, and the adaptive management program. As you know, the most important aspects of the project from the Department's perspective are protection and enhancement of downstream fish production, restoration of fish production in the upper watershed, full mitigation for impacts to wildlife from the proposed changes to the project, and initiation of replacement for other outstanding project deficiencies and damages.

We look forward to working with you in the future to accomplish this project.

Sincerely,

Bob Turner

Robert Turner
Director

RT:DM:pd

cc: U.S. Fish and Wildlife Service
National Marine Fisheries Service
Muckleshoot Indian Tribe
Brad Caldwell, Washington Department of Ecology

United States Department of the Inte[illegible]

FISH AND WILDLIFE SERVICE
North Pacific Coast Ecoregion
Office of the Assistant Regional Director
3773 Martin Way E., Bldg. C, Suite 101
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EN-PL-CP
2ES
Derek

March 7, 1996

Colonel Donald T. Wynn
District Engineer
Seattle District Corps of Engineers
P.O. Box 3755
Seattle, WA 98124-2255

Dear Colonel Wynn:

I wish to express the U.S. Fish and Wildlife Service's (Service) support for the U. S. Army Corps of Engineers' (Corps) and the Tacoma Public Utilities' two-phase proposal, as outlined and presented at the February 9, 1996, meeting. Specifically, the Service supports Phase One of the Howard Hanson Additional Water Storage Project through the pre-construction, engineering, and design phase. We have a strong interest in the restoration of the fish and wildlife resources of the Green River and look forward to working with you, the National Marine Fisheries Service, Washington Department of Fish and Wildlife and the Muckleshoot Indian Tribe toward this goal.

The phased and adaptive management approaches being proposed are desirable because they offer the flexibility needed to make adjustments to the project as new information becomes available. The proposal has the potential to correct the fish passage problem at the existing Howard Hanson Dam, while reducing the impact from the pool raise to an acceptable level by including fish and wildlife habitat improvements both upstream and downstream from the dam.

We are encouraged by your staff's willingness to address the fish and wildlife concerns during the development of the project details. As we have previously discussed, there are several issues that must be satisfactorily addressed and resolved prior to the Service giving its final support for the implementation of the project. For example, agreement needs to be reached on the timing and rate of reservoir refill and the amount and allocation of the additional storage, because of their effect on fish and wildlife resources. However, we are confident that these and other concerns will be resolved during the National Environmental Policy Act review process.

We will participate in the review of the Corps' draft feasibility report and draft Environmental Impact Statement, and use these documents as the basis for preparing the Service's Coordination Act Report.

We look forward to working together with you on this project.

Sincerely,

Curt Smitch

Curt Smitch
Assistant Regional Director

CS:gg:jmc

[An original letter sent to Mark Crisson, Tacoma Public Utilities]

cc: Brad Caldwell, Washington Department of Ecology
Glen St. Amant, Muckleshoot Indian Tribe
Will Stelle, National Marine Fisheries Service
Robert Turner, Washington Department of Fish and Wildlife

rcc'd
25Mar96

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

MAR 19 1996

Colonel Donald T. Wynn
US Army Corps of Engineers - Seattle District
Attn: Mr. Derek Chow
P.O. Box 3755
Seattle, WA 98124-2255

Re: Howard Hanson Dam Additional Storage Project, Tacoma Public Utilities Water Division, Green River in King County, WA

Dear Colonel Wynn:

The National Marine Fisheries Service (NMFS) has completed its review of the Howard Hanson Additional Storage Project in which the Corps of Engineers proposes to store up to 20,000 acre feet of water in Howard Hanson reservoir using the City of Tacoma water right of 100 cfs between February 15 and June 30 of each year. Our comments are based upon NMFS' responsibility for the protection and enhancement of marine, estuarine, and anadromous fishery resources and their supporting habitats. NMFS staff have participated in development of the fish passage alternative and reviewing and commenting on the proposals for additional storage behind Howard Hanson Dam.

NMFS supports phase one of the Project through the pre-construction, engineering, and design phases. We believe that favorable progress has been made toward resolving fish passage problems and the downstream impacts associated with additional water storage. Establishment of a technical team to refine specific performance criteria for fish passage and delay, a monitoring plan, and an adaptive management program are all positive steps necessary to achieve the maximum benefits for anadromous fish at this project.

Thank you for the opportunity to comment on this proposal. I want to commend both you and your staff for the constructive approach they have brought to examining outstanding issues and exploring options for resolving those issues. We look forward to participating in the first phase development of the Howard Hanson Dam Additional Water Storage Project as outlined in your February 9, 1996 proposal. Questions regarding this letter should be directed to Bob Vreeland of my staff, at (206) 526-6172.

Sincerely,

William W. Stelle, Jr.
Regional Director

cc: WDFW - R. Turner
WDOE - Brad Caldwell
USFWS - C. Smitch
Muckleshoot Indian Tribe - Stanley Moses, Holly Coccoli
City of Tacoma - Mark Crisson

23 April 96

Planning Branch

Dr. Robert Whitlam
Department of Community Development
Office of Archaeology and Historic Preservation
Post Office Box 48343
Olympia, Washington 98504-8343

SUBJECT: Habitat Restoration Features, Howard A. Hanson Dam

Dear Dr. Whitlam:

The Seattle District Corps of Engineers proposes to store additional water at the Howard A. Hanson Dam under two separate projects. The project areas are located on the Green River in King County, Washington. During 1995, the Corps conducted a cultural resources survey between elevations 1,141 feet and 1,206 feet. The report by Larson Anthropological/Archaeological Services (Lewarch et al. 1996) was previously coordinated with your office. This study recorded and assessed four historic sites within the project area, none of which were determined eligible for the National Register of Historic Places.

As part of these projects, the Corps, and the city of Tacoma, also plan to implement habitat improvements on the Green River, primarily within the reservoir area. These improvements involve ground disturbing activities generally consisting of meadow creation; vegetation clearing and planting; creation and enhancement of wetlands and ponds; and creation of river side channels. At this time, the exact location for habitat improvement projects is still under study. However, we are enclosing maps which indicate areas currently under consideration. Some areas have previously been investigated for cultural resources, others have not.

The intent of this letter is to introduce this aspect of the proposed project and also to solicit your comments on our planned actions. We propose the following for your consideration. Each area planned for wildlife or fish habitat restoration will be reviewed by a staff archeologist. If the proposed activity will not cause subsurface impacts or will not have the possibility of affecting cultural resources, then no field work will be conducted. For activities that will cause subsurface disturbance, we expect to conduct cultural resources surveys in areas which have not been previously investigated. Fourteen archeological sites are recorded within the active reservoir drawdown zone. These sites were recorded in 1985 by Benson and Moura and have never been assessed for National Register eligibility. If any of the previously mentioned habitat improvement activities will affect these sites, we propose to conduct National Register assessments and treatment as appropriate. We anticipate conducting all cultural resources investigations in consultation with your office and the Muckleshoot Tribe.

We request your comments on the proposed fish and wildlife habitat restoration activities associated with the Howard Hanson projects. Thank you for your assistance and we look forward to working with you on this project.

Sincerely,

Karen S. Northup, Chief
Environmental Resources Section

Enclosure

CF with Enclosure:
Mrs. Virginia Cross, Chairperson
Muckleshoot Tribal Council
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Auburn, Washington 98002-9763

Mr. Walter Pacheco
Community Service Coordinator
Muckleshoot Tribe
39015 172nd Avenue Southeast
Auburn, Washington 98002-9763

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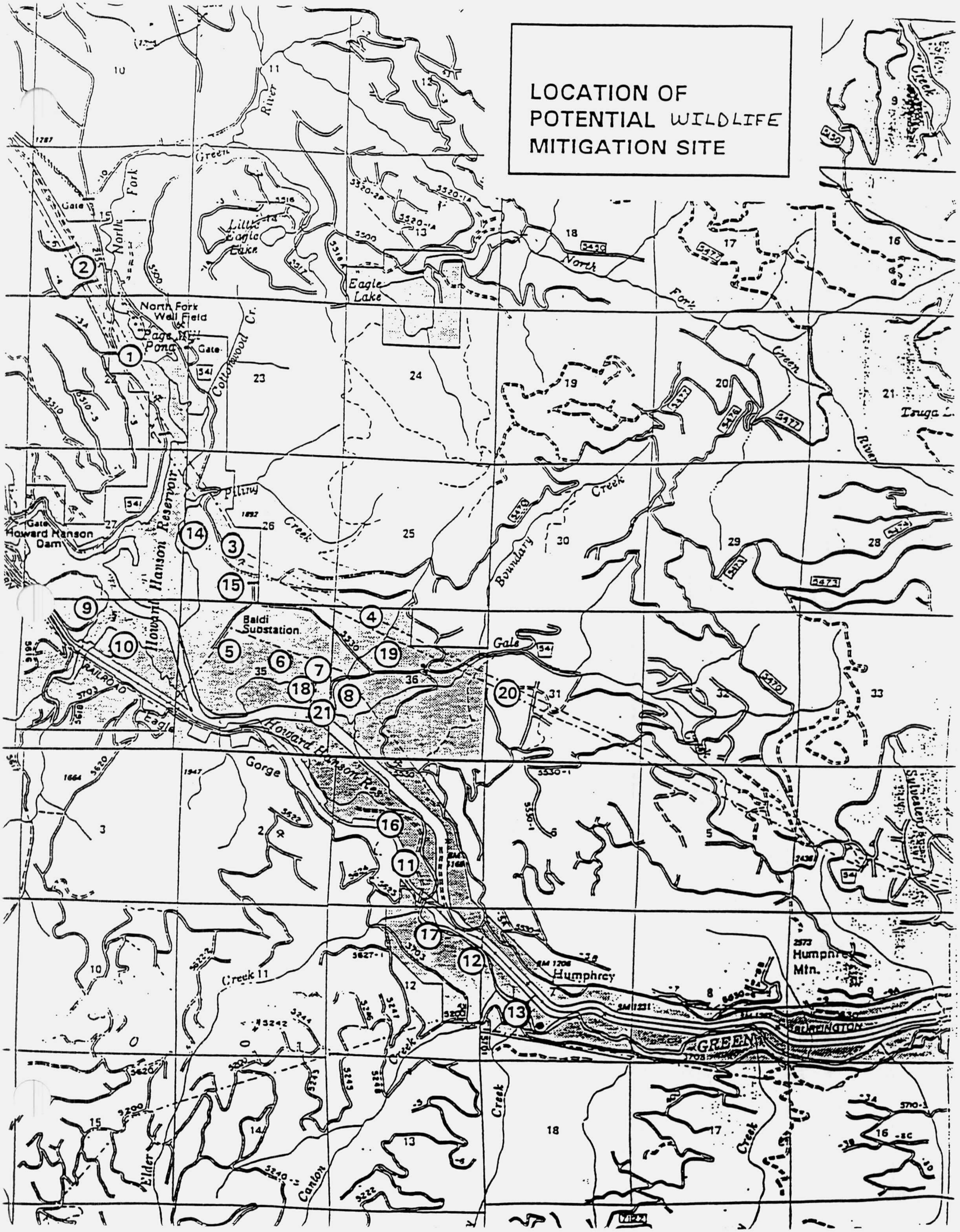
LOCATION OF
POTENTIAL WILDLIFE
MITIGATION SITE
North Fork Well Field
Page Mill Pond
Gate
Howard Hanson Dam
Howard Hanson Reservoir
Cottonwood Cr.
Little Eagle Lake
Eagle Lake
North Fork Green River
Boundary Creek
Baldi Substation
RAILROAD
Eagle Gorge
Howard Hanson Res.
Humphrey
Humphrey Mtn.
GREEN
Elder
Canton Creek
Sylvester Creek
Tsuga L.
1
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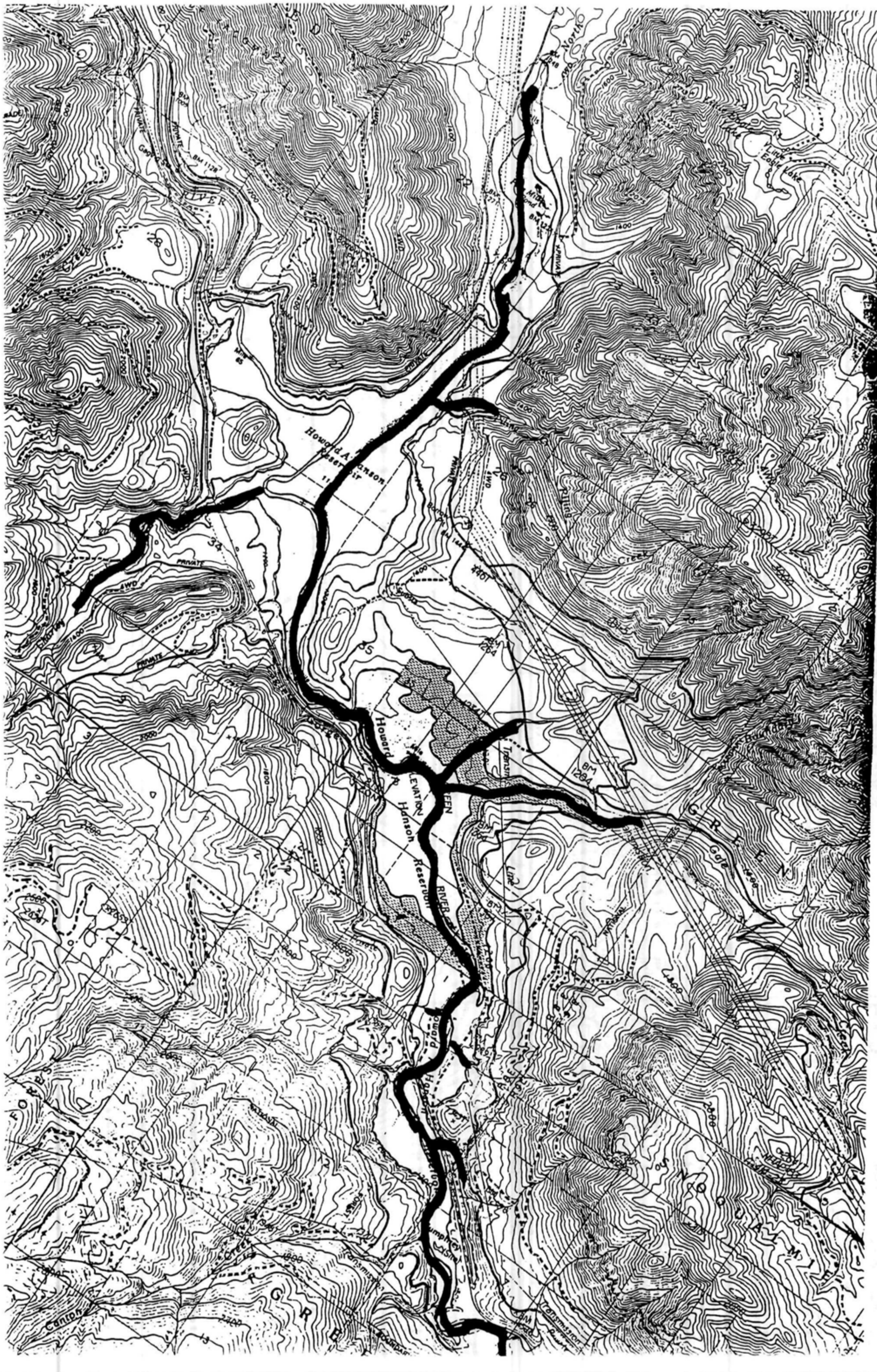

Location of Potential FisH Habitat Restoration Site

From: Eagle Gorge, Cougar Mt., Greenwater S.G. Quads

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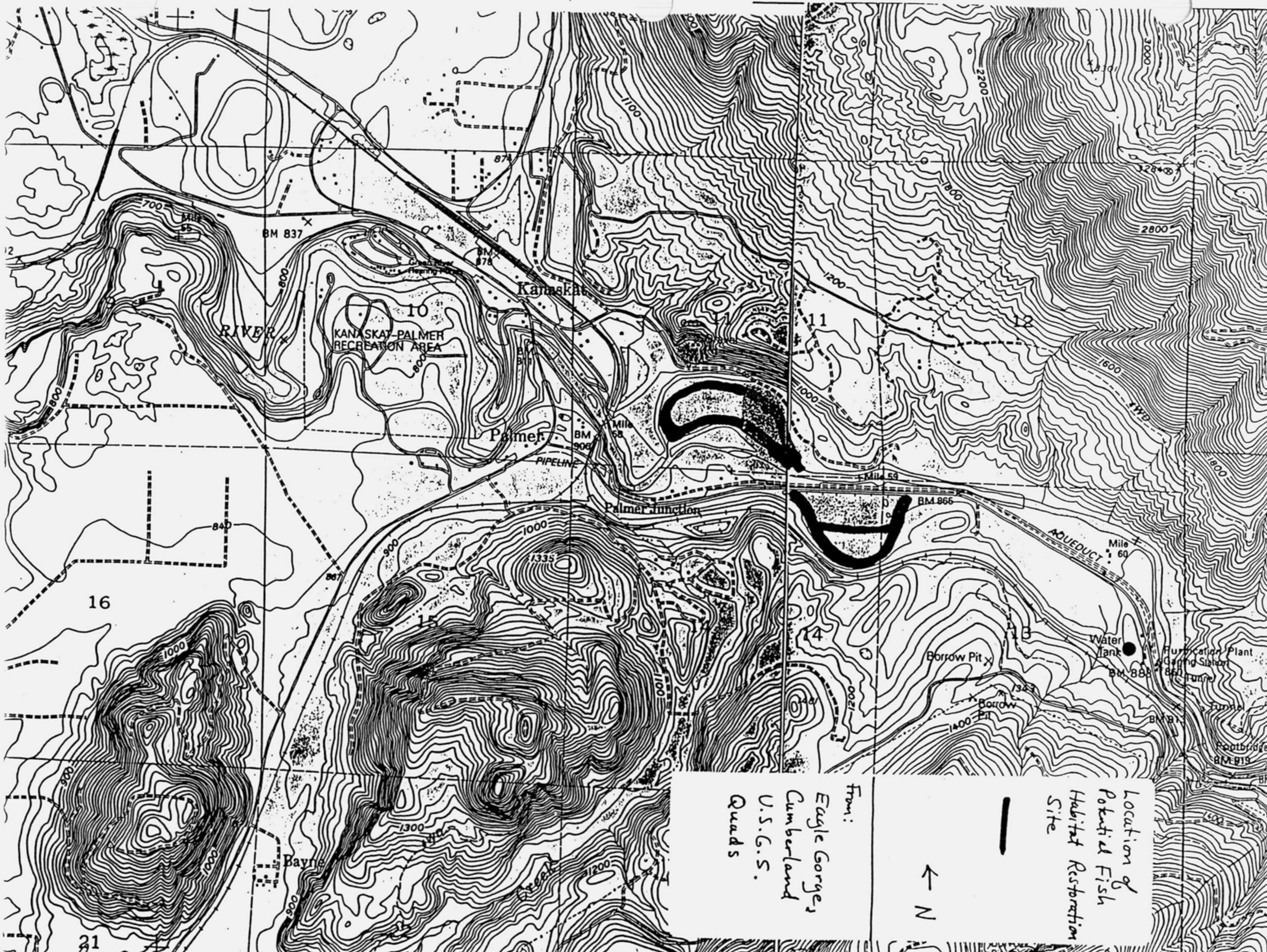

Kanaskat
Palmer
Palmer Junction
KANASKAT-PALMER RECREATION AREA
RIVER
PIPELINE
AQUEDUCT
BM 837
BM 866
BM 888
Mile 59
Mile 60
Water Tank
Purification Plant
Gaging Station
Tunnel
Borrow Pit
Footbridge
Bayne
Location of Potential Fish Habitat Restoration Site
N
From: Eagle Gorge, Cumberland U.S.G.S. Quads

5/6/96 KSN

STATE OF WASHINGTON

DEPARTMENT OF COMMUNITY, TRADE AND ECONOMIC DEVELOPMENT

OFFICE OF ARCHAEOLOGY AND HISTORIC PRESERVATION

111 21st Avenue S.W. • P.O. Box 48343 • Olympia, Washington 98504-8343 • (360) 753-4011

May 3, 1996

Ms. Karen S. Northup
Environmental Resources Section
Seattle District, Corps of Engineers
Post Office Box 3755
Seattle, Washington 98124-2255

Log: 043096-03
Re: Habitat Restoration Features, Howard A. Hanson Dam

Dear Ms. Northup:

Thank you for contacting our office regarding the Habitat Restoration Features for the Howard A. Hanson Dam and your plan for addressing cultural resource issues. We concur with the approach outlined in your letter of April 29. We request you detail for us as an attachment the types of activities you believe would not cause subsurface impacts or will not have the possibility of effecting cultural resources.

Please feel free to contact me at (360) 753-4405 should you have any questions.

Sincerely;

Robert G. Whitlam, Ph.D.
State Archaeologist

RGW:tjt

MUCKLESHOOT INDIAN TRIBE

39015 172nd Avenue S.E. • Auburn, Washington 98002-9763

Phone: (206) 939-3311 • FAX: (206) 939-5311

6/14/96

June 3, 1996

Karen S. Northrup
Environmental Resources Section
Army Corps of Engineers - Seattle District
P.O. Box 3755
Seattle, WA 98124-2255

Re: Habitat Restoration Features, Howard A. Hanson Dam

Dear Ms. Northrup,

In reviewing your proposed mitigation for the Howard Hanson Dam Extra Storage Project, the proposed fish and wildlife enhancement projects will need to be monitored. This will assure there will not be any impacts on cultural resources. The Tribe fully supports the efforts to accommodate the needs of the natural resources affected by the project. The principle being that if the added storage is going to impact fish and game resources then all areas and all resources being impacted by the project as a whole should be considered. Some resources within the reservoir are not being considered, specifically those Archaeological sites that are below the 1141 foot level on the reservoir.

The Howard Hanson Dam Project has been impacting these archaeological sites since its operation. Those sites have previously been identified but not assessed for its significance. I do not see any reason not to complete a comprehensive assessment of the sites below the 1141 foot zone. If an assessment is not completed on those areas, they will ultimately be lost by the fluctuation of reservoir levels and the resultant erosion by water/wave action.

The Tribe therefore will recommend the areas below the 1141 foot level in the reservoir be included in the National Register assessments. As part of the mitigation of the Extra Storage Project this should be done. The mere fact that the operation has impacted these areas for years without mitigation is an issue that needs to be dealt with within the context of this project.

We are pleased to work with you on this project and look forward to our continued involvement.

Sincerely,

Walt Pl

Walter Pacheco
Community Services Coordinator

cc: LAAS
SHPO
ACE-Col.

ENDANGERED SPECIES COORDINATION

1. Biological assessments (BA's) for the Additional Water Supply Project have been prepared on three occasions--originally on July 27, 1992; again on September 6, 1996; and finally, on October 20, 1997. The U.S. Fish and Wildlife Service (FWS) did not concur with the conclusions in the first assessment regarding marbled murrelets and spotted owls (which was "no effect" for both of these species). The FWS requested the Corps to conduct surveys to confirm that these species are not present in the project area. The Corps utilized data from Washington Department of Ecology (DOE) spotted owl surveys, which confirmed that spotted owls are not present in the Charlie Creek drainage adjacent to the project area. Through coordination with the Tacoma Water Division forester, the Corps has determined that the forest age and structure in the project area is not suitable for spotted owl nesting. These findings were included in the 1996 BA.

The Corps invited one of Washington Department of Fish and Wildlife's experts on marbled murrelets to visit the project area in 1993. He indicated the project area contained only three very small stands of trees that had the potential for nesting by marbled murrelets; and, additionally, that the stands were too isolated from one another, and too far removed from viable habitat, to support nesting murrelets. He recommended, however, that we conduct a single year of murrelet surveys following the protocol developed by the Pacific Seabird Group (normally this requires two years of survey) to confirm that murrelets were not present. Following this advice, the Corps conducted a survey in the summer of 1994, which resulted in no detections of marbled murrelets in the project area. This information was then included in the 1996 BA.

The FWS expressed informal concurrence of the spotted owl and marbled murrelet effect conclusions ("not likely to adversely effect"), but indicated a lack of confidence with the information provided for bald eagles in the 1996 BA. The lack of confidence was a result of "new" downstream flow criteria that agencies had recently recommended. The effect of different flows downstream from Howard Hanson Dam on bald eagle food supply and foraging behavior was not addressed in that BA. Effects upstream of the dam were also somewhat in question, particularly with regard to clearing of the timber from the inundation zone of the higher reservoir. The FWS felt that this kind of information will not be available until the project criteria are well established, and the effect on steelhead and salmon can be determined (and therefore the effect on bald eagle prey supply can be assessed). At the time it appeared unlikely that adequate data (or even agency agreement) that would satisfy FWS as to bald eagle effects of the project could be achieved for several years; as a result, the Corps elected to withdraw the 1996 BA. This seemed to be appropriate, as construction of projects must follow completion of BA's (and consultation with FWS) by no more than 180 days; thus, even if consultation could be completed now, consultation would have to be reinitiated just prior to project construction, to assure that any changes in project design or operation, or changes to the endangered species list or the Act itself, would be considered. Thus, it made sense to withdraw the BA and reinitiate consultation at a time more appropriately timed to project construction, especially considering the unlikely resolution of key issues regarding fish and water management following implementation of the project.

However, Higher Authority pointed out in the Alternative Formulation Briefing of the project, that to move forward with the Feasibility Report and EIS without a completed BA and FWS concurrence would very likely not be in compliance with the Endangered Species Act. Furthermore, HA pointed out that it is in the Corps' best interest to complete Section 7 consultation at this time, so that reasonable and prudent measures proposed by FWS at this time would not "surprise" us in the future (i.e., if we did not complete coordination during Feasibility).

Thus, we re-initiated consultation with the FWS on October 20, 1997. However, FWS still was uncertain about downstream fish survival, and asked to delay a response to the BA until agencies could agree on an operation of the dam that would provide better certainty on fish survival. Common ground was reached in December, 1997, in the description of both "with project" and "without project" conditions. This allowed completion of the BA, and, more importantly, gave FWS confidence that it could issue a BO without fear of reproach for doing so while lacking key information. Thus, a revised edition of the third version of the BA was provided to the FWS in mid-January, 1998. As of this writing, FWS has not written its BO.

In addition, at least two species of fish--bull trout and the Puget Sound evolutionary significant unit of chinook salmon--may be listed in the next two or three years. In the meantime, data will be gathered that will help us assess the potential effects of the project on these species, should they be listed. Resource agencies will also continue to work to find workable solutions to restoring anadromous fish runs in the Green River.

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO
ATTENTION OF

Planning Branch

Mr. David C. Frederick, State Supervisor
USDI (Fish and Wildlife Service)
Fish and Wildlife Enhancement
Olympia Field Office
510 Desmond Drive, Suite 101
Lacey, Washington 98503-1273

OCT 17 1997

Reference: Howard Hanson Dam Additional Water Supply Project, Feasibility Level Study

Dear Mr. Frederick:

The Seattle District, Corps of Engineers, is preparing a draft environmental impact statement and feasibility report for the referenced action. Pursuant to the Endangered Species Act, a biological assessment (BA) addressing potential impacts to bald eagles, marbled murrelets, spotted owls, gray wolves, and grizzly bears, plus two candidate species, at the Howard Hanson Dam project in King County,Washington, has been prepared and is enclosed for your review and concurrence. A biological assessment was previously sent to you in September, 1996. This BA was withdrawn, after discussion with your agency, because operational plans for the project were still being discussed and it was not possible to address downstream impacts to bald eagle prey base, until a final operation had been determined. We have now identified the operational criteria that would be in use during Phase I of the project, and are re-submitting our BA at this time, as we would like to include both the BA and your biological opinion in our Feasibility Report and EIS, due for completion in mid-December, 1997. The early identification of any conservation measures not already proposed in the BA would help us to refine budgets and schedules for the plan development stage of the project.

The enclosed BA represents the opinion of the Seattle District, Corps of Engineers, that the proposed project would not likely adversely affect the listed and candidate species found and potentially found in the vicinity of the Howard Hanson Dam project.

If you have any questions about the BA, please contact Mr. Ken Brunner at (206) 764-3479.

Sincerely,
Cyrus M. McNeely
Cyrus M. McNeely
Chief, Environmental Resources Section

Enclosure

HOWARD HANSON DAM ADDITIONAL WATER STORAGE PROJECT
BIOLOGICAL ASSESSMENT
JANUARY 15, 1998

1.0 BACKGROUND

The city of Tacoma, Washington receives a majority of its municipal and industrial water supply from the Green River through their diversion structure at river mile (RM) 61.0. The Howard A. Hanson Dam (HHD), a U.S. Army Corps of Engineers dam, is located within the City of Tacoma's watershed on the upper reach of the Green River, at RM 64.5. HHD provides winter flood control and summer low flow enhancement. The reservoir behind HHD has never been filled to its authorized elevation of 1206 feet, but maintains an established conservation pool elevation of 1141 feet during spring and early summer for fishery low-flow augmentation, until inflow can no longer keep up with outflow, at which point the reservoir slowly drains to its winter minimum of approximately 1070 feet.

Tacoma recognizes the need for an additional water supply, especially during the summer months, not only because of the high water demand during this time of the year, but also because natural flow withdrawals are constrained to protect fish. The existing storage is entirely dedicated to fish needs and therefore not available to Tacoma. A certified reconnaissance study completed by the U.S. Army Corps of Engineers determined that additional water storage behind HHD is the most viable source of municipal and industrial water supply for Tacoma and its service area. The conservation pool would be increased in two phases: the first phase would increase the annual conservation (summer) pool elevation by 26 feet, to an elevation of 1167 feet. The second phase (which would occur at least five years after implementation of Phase I) would raise the annual conservation pool to elevation 1177'. Both of these pool raises results in loss of terrestrial and wetland habitat adjacent to the existing reservoir; the project also results in downstream in-stream effects. Finally, the project also includes fish passage over HHD, resulting in the re-introduction of anadromous salmonids to the upper watershed.

The U.S. Fish and Wildlife Service (USFWS) in a letter dated January 22, 1996 identified five federally listed animal species and two candidate species which may occur in the project vicinity. Included in this list were bald eagles (*Haliaeetus leucocephalus*), marbled murrelets (*Brachyramphus marmoratus marmoratus*), northern spotted owls *(Strix occidentalis caurina*), gray wolves (*Canis lupus*) and grizzly bears (*Ursus arctos*). Spotted frogs (*Rana pretiosa*) and bull trout (*Salvelinus confluentus*) were listed as candidates (with 15 other species; in a Notice of Review on February 28, 1996, the USFWS dropped many species from the candidate list; for the Howard Hanson project, only the bull trout and spotted frog remain as candidate species). The potential impacts to these listed and candidate species as a result of the Howard Hanson reservoir inundation project are outlined in this biological assessment.

2.0 GENERAL PROJECT IMPACTS

Phase I would result in the inundation of about 325 acres of terrestrial and wetland habitats, while Phase II would inundate 153 acres of habitat. Most plants in the inundation zones would die during the first season of inundation, although a few species of plants that are more tolerant of inundation would survive for a longer period than species intolerant of inundation. The City of Tacoma intends to remove some merchantable timber from the inundation zone, and leave the remainder of trees. This point is currently being debated by resource agencies, who would prefer to see no trees cut from the inundation zone, in order to provide habitat for juvenile salmonids. In the event that merchantable trees are cut, the Corps of Engineers and the City of Tacoma will inventory the inundation zone and designate particular trees which are not to be cut, even in the merchantable areas. In addition, to insure that suitable perches will be maintained for raptors, dead snags would be retained and allowed to fall as they rot.

3.0 PROJECT IMPACTS ON LISTED SPECIES

3.1 Bald Eagle

3.1.1 Habitat Requirements/Population Status

The bald eagle is listed as threatened in Washington on the Federal list of endangered, threatened, and proposed animals and plants. The bald eagle (*Haliaeetus leucocephalus*) is found only in North America and ranges over much of the continent, from the northern reaches of Alaska and Canada down to northern Mexico. Bald eagles migrate to wintering ranges in Washington State in late October and are most commonly found along lakes, rivers, marshes, or other wetland areas west of the Cascades, with an occasional occurrence in eastern Washington.

The characteristic features of bald eagle breeding habitat are nest sites, perch trees and available prey. Bald eagles primarily nest in uneven-aged, multi-storied stands with old-growth components (Anthony, et al. 1982). Factors such as tree height, diameter, tree species, position on the surrounding topography, distance from water, and distance from disturbance also influence nest selection. Live, mature trees with deformed tops are often selected for nesting and nests are often re-used year after year (USFWS, 1995). Snags, trees with exposed lateral branches, or trees with dead tops are often present in nesting territories and are critical to eagle perching, movement to and from the nest and as points of defense of their territory. Perches used for foraging are normally close to water where fish, waterfowl, seabirds, and other prey can be captured.

3.1.2 Known Occurrences in the Project Vicinity

Bald eagles have been sighted every month of the year near the reservoir, however, no nests have been confirmed in the project area. The bald eagle is year round resident within the Howard Hanson reservoir area. Although its behavior in the area is not documented, it most likely feeds on waterfowl that winter on the lake; up to two hundred ducks may be on the reservoir at any one time, providing a readily available food source for bald eagles. The forests surrounding the reservoir provide a large number of perches and potential nest trees. Food is the limiting resource, and no more than four bald eagles have been seen in the vicinity of the reservoir at any one time during the winter. Another potential limiting factor is the seasonal drawdown of the reservoir during the winter (to 1070 feet) which leaves a broad, unvegetated band between the forest and the reservoir and may discourage use by bald eagles; however, the real effect of the drawdown on eagle use has not been investigated and is unknown. The reservoir is refilled during spring and is usually raised to 1141' by mid-May.

Anadromous salmonids historically were probably a more important food source in the Green River watershed for bald eagles prior to construction of Howard Hanson Dam than they are now. The dam blocked upstream passage and ended spawning above the dam. At least one account indicates as many as 15 bald eagles at Eagle Gorge prior to construction of the dam, which may well have been because of spawning salmon at that location (Eagle Gorge is now part of the reservoir behind Howard Hanson Dam). The Additional Water Supply project would not only result in higher reservoir levels, but would also result in altered downstream flows. The issues surrounding flows in the Green River and the various stocks of salmon are complex. Because salmon have historically been important to bald eagles (and still provide eagles with a food source downstream from the dam), the following discussion goes into some detail on the existing (baseline) condition of salmon stocks in the Green River, and the expectations following implementation of Phase I, and then Phase II, of the Additional Water Supply project. Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), cutthroat trout (*O. clarki*), and steelhead (*O. mykiss*) are the five main salmonid species supported by the Green River. In addition, char (*Salvelinus spp.*) may be found in the watershed, but there is little information to substantiate their status.

3.1.3 Effects of the Action—Phase I

3.1.3.1 Perches

Only the merchantable timber existing in the inundation zone will be logged prior to inundation. In addition, prior to logging, potential perch trees would be marked so that they would not be cut. Thus, a relatively small number of living perch trees will be removed from the existing habitat. Although the time frame for the reservoir operation would remain nearly the same, the position of perches and forest, and the configuration of the reservoir shoreline would be changed; a rough estimate, based on use of a 1"=800' topographic map, is that the forest would be as much as 800 feet further removed from the low pool than under existing winter conditions. In areas of steep banks, the shoreline may be as little as 30-50 feet further removed. Artificial perch poles will be erected in specific locations within the inundation zone to compensate for the loss of existing key perches. According to the USFWS (1993), artificial perches have been used by many raptor species and are important to wintering bald eagles in situations where natural perches are lacking.

3.1.3.2 Food Supply

A number of factors could affect waterfowl numbers on Howard Hanson reservoir. First of all, there are few (resident) fish larger than 6" in the reservoir, although there are anadromous salmonids in the reservoir that were outplanted in the upper watershed that have reached lengths of 10" (Ging, 1998). Bald eagles typically do not eat fish less than 6" in length, as it is not worth the energy expended to catch them. Outplanting above the reservoir may not continue for coho and chinook salmon without the project, and if this occurs, fish resources in the reservoir (for bald eagles) would decline. Also, removal of trees would potentially result in less protection of the reservoir from wind, and may make the reservoir less attractive to waterfowl due to rougher water. On the other hand, for the first few years of inundation to 1167', the reservoir will be more productive with the introduction of nutrients from the newly inundated strip of forest land between 1141' and 1167' elevations; should this occur, waterfowl may be enticed to stay because of the enhanced food supply--it is impossible to predict whether wind or food supply would have the greater effect on waterfowl numbers, or whether these effects would in fact occur. Experience with other reservoirs indicates that the nutrients first increase, then are depleted after a few years and the reservoirs become less productive *(Appendix F, Section 2)*. For this analysis, we would expect a fairly similar scenario to occur in Howard Hanson Reservoir: resident fish populations (cutthroat and rainbow trout, mountain whitefish) as well as those of wintering waterfowl would initially go up with the increase in nutrients, then fall again as nutrients decline over a period of years. Anadromous fish populations should diverge from the above pattern given the new fish passage facility; as natural production improves the number of juvenile salmonids should increase, while adult numbers (and carcasses) should increase dramatically. This increase in juvenile salmonid number and release of ocean-derived nutrients from carcasses could also result in increased resident fish number and size. Lastly, we would not expect the number of either resident fish or waterfowl to drop below current wintering populations, since the reservoir will maintain its current winter operation.

Food supply for bald eagles is expected to significantly increase in the upper watershed not only as a result of restoration efforts, but also as a result of increased nutrients present in the reservoir following inundation. Currently, no anadromous adult salmon exist in the upper watershed, though several million juveniles are outplanted in an effort to restore runs to the Green River. One objective of the fish restoration project would be to boost the summer/fall adult salmon population to up to 10,000 individuals (estimated total escapement; *Appendix F, Section 2*) within 20 years. This increase in fish number will bring about a large increase in available nutrients, carcasses, and fish greater than 6" in size. In addition, restoration efforts within the reservoir (including establishment of sedge meadows in the currently barren "bathtub ring" exposed during drawdowns) is expected to increase the population of nesting waterfowl, which currently is quite small (fewer than 10 nesting pairs). Thus, food supply for bald eagles in the upper watershed would be heightened.

Downstream, the situation is less predictable. In general, survival of anadromous salmonids in the stream is influenced by many factors, including winter flooding and scour of incubating eggs, flow levels during juvenile emigration in the spring, minimum baseflows during summer and fall, maximum and minimum water temperatures, dissolved oxygen supply, quality of instream and riparian habitats, suspended sediment levels, and predation. Once they leave their natal streams, survival of juvenile salmon and steelhead is dependent on a number of physical and biological factors including estuary habitat quantity and quality, predation by fish, mammals or marine birds, climatic change such as elevated ocean temperatures, and by harvest by commercial, sport, or tribal fisheries.

The Howard Hanson Dam project provides primary control of mainstem flows in the Green River, which may have secondary effects on water temperature, turbidity, and predation of juvenile anadromous salmonids. The current population status of lower river anadromous stocks can be somewhat related to operation of Howard Hanson Dam. Tradeoffs occur as a result of the operational change to providing additional storage (filling the reservoir in spring to early summer) for late summer and fall discharges to the river: less water is provided to the Green River below Howard Hanson Dam in spring and early summer, which may result in reduced spawning (steelhead) and hatching (steelhead and salmon) success. The following analysis discusses these effects on the various salmon stocks and the resulting effects on bald eagles.

Phase I of the AWS project includes implementation of all restoration features which include the downstream fish passage facility, habitat restoration projects above and below the dam, and storage of 20,000 ac ft of M&I water supply. As part of the Second Supply Project, Tacoma will implement a mitigation agreement that will include an upstream fish passage facility, a fish restoration facility which will provide up to 500,000 coho and chinook and 350,000 steelhead fingerlings, and improved instream flows during summer and fall.

3.1.3.3. Coho Salmon. Puget Sound/Strait of Georgia coho salmon stocks have been candidate species for listing under the Endangered Species Act. A preliminary stock status review considered that "listing is not presently warranted" (WDFW 1997). The lower and middle Green River basin coho run is mixed with Soos Creek hatchery stocks, but the upper Green River portion of the run may be native. The runs of wild, natural spawned fish have not met escapement goals (8,700 fish) in the recent past (SASSI, 1993). Adult coho spawn in the Green River from September through January; spawning generally occurs in tributaries and side channels. The fry emerge from March through June and rear in side channels and pools of the mainstem and its tributaries for one year before migrating down to the Duwamish estuary and out to Puget Sound. Since 1983, hatchery fingerlings have been planted above HHD. Fry-to smolt survival rates for these planted fish have been lower than other watersheds (Dilley and Wunderlich 1993). These lower fry-to-smolt survival rates are probably a result of high stocking rates and low survival rates of smolts (25% or less) migrating through Howard Hanson Dam and Reservoir (*Appendix F, Section 2*). Historically, an estimated 9-27,000 coho salmon spawned in the watershed above the Tacoma Diversion Dam (Grette and Salo 1986). Currently, there is no established escapement goal for the upper Green River above the Diversion Dam.

3.1.3.4. Chinook Salmon. Puget Sound/Strait of Georgia chinook salmon stocks have been candidate species for listing under the Endangered Species Act. A preliminary stock status review considered that Puget Sound Chinook are "likely to become endangered" (WDFW 1997). A tentative NMFS decision date for proposed listing of chinook ESU's is expected for January of 1998. Summer/fall chinook of the Duwamish/Green River basin are distinguished from other Puget Sound chinook stocks by geographic isolation. The lower and middle Green River basin chinook run is mixed with Soos Creek Hatchery stocks, but the upper Green River portion of the run may be native. Coded-wire tag recoveries indicate that some hatchery strays are spawning naturally in the river (SASSI 1993). The Muckleshoot Indian Tribe is preparing to conduct genetic stock identification of the run in 1998.

Adult returns to the Green River and its tributaries have averaged 7,600 from 1987 to 1992 with an increasing trend (SASSI 1993). The runs have met escapement goals (5800 fish) in the recent past but harvest has been severely curtailed due to lower than expected smolt-to-adult survival rates. Stock status is rated healthy. Adult chinook spawn in the Green River from August through November, with peak spawning in September and October; spawning generally occurs in the mainstem from RM 28 to the Diversion Dam and in the largest tributaries. The fry emerge from January through March and rear in side channels and pools of the mainstem for days to months before migrating down to the Duwamish estuary and out to Puget Sound: peak emigration occurs from March to June. Since 1983, hatchery fingerlings have been planted above HHD. Fry-to smolt survival rates for these planted fish have been lower than other watersheds (Dilley and Wunderlich 1993). These lower fry-to-smolt survival rates are probably a result of high stocking rates and low survival rates of smolts migrating through Howard Hanson Dam and Reservoir. Historically, an unknown number of chinook salmon spawned in the watershed above the Tacoma Diversion Dam: an estimated 100-400 adult chinook were captured at the Diversion Dam after its completion from 1911-1913 (Grette and Salo 1986). Currently, there is no established escapement goal for the upper Green River above the Diversion Dam.

3.1.3.5. Chum Salmon. Puget Sound chum salmon are candidate species for listing under the Endangered Species Act. A preliminary stock status review considered that Puget Sound fall/summer/winter chum salmon are presently not warranted for listing (WDFW 1997). Two chum stocks are recognized in the Green River system (SASSI 1993). The Crisp (Keta) Creek fall chum stock originated from releases of Quilcene and Hood Canal stocks from the Keta Creek hatchery in the early 1980's. This stock is considered healthy. The Duwamish/Green stock has been considered a remnant native stock, but their status is unknown. A genetic stock inventory conducted by the Muckleshoot Indian Tribe found that the natural spawners were composed of Hood Canal and South Puget Sound hatchery stocks with no evidence of a native stock component (M. Mahovolitch, pers. comm.). The natural spawning run is considered to be in a rebuilding state and an adult escapement goal has not been established.

Adult chum salmon migrate up the Green River from early November to the first week of December. Spawning occurs from mid November through December, in the mainstem Green River between Burns Creek and Crisp Creek (SASSI 1993). Recent surveys have found spawners up to the RM 45 in side channels of Flaming Geyser State Park (B. Furstenberg, King County, pers. comm.) . Muckleshoot Tribal biologists surveyed the Green River during 1996 and reported significant chum spawning in side channels in the middle and lower Green River reaches. The fry emerge from mid-February to July and rear from days to weeks in side-channel and mainstem backwater habitats. The peak downstream migration of chum salmon fry occurs from late March through May.

3.1.3.6. Winter Steelhead. Puget Sound steelhead have been candidate species for listing under the ESA. A stock status review considered that Puget Sound steelhead are not presently warranted for listing. Steelhead are differentiated into two types: winter steelhead and summer steelhead. Winter and summer steelhead are differentiated by timing of adult return but share common juvenile behavior patterns. Winter steelhead adults return to the Green River from November through early June and summer adults from April through November (Caldwell 1994). Winter steelhead are native to the Green River while summer steelhead are non-native to the Green River (Skamania River) and are primarily maintained by hatchery plants. Winter steelhead spawn from January through June with the peak in spawning in April and May. Spawner escapements for wild winter steelhead has been close to or exceeds goals (2100 fish) in most years, and the status of the stock is healthy. A limited number of summer steelhead spawn in the Green River, usually from mid-January to early April. Many of these fish spawn below the Palmer rearing ponds at RM 56. A significant difference between steelhead and Pacific salmon life history is that not all steelhead die after spawning. Steelhead are capable of repeat spawning. Repeat spawning in Washington ranges from of 4.4 to 14.0 percent of total spawning runs (Wydoski and Whitney 1979).

Both winter and summer juvenile steelhead rear in freshwater for one to two years, mostly two, before migrating to the ocean. Juvenile downstream migration occurs from April through July, with peak migration in mid-April (*Appendix F, Section 5*). Since 1982, hatchery fingerlings have been planted above HHD. Fry-to smolt survival rates for these planted fish have not been estimated but probably follow the trend for coho and chinook salmon, which have been lower than other watersheds (Dilley and Wunderlich 1993). The lower fry-to-smolt survival rates are probably a result of high stocking rates and low survival rates (25%<) of smolts migrating through Howard Hanson Dam and Reservoir. Historically, an estimated 500-5200 adult steelhead were captured at the Diversion Dam after its completion from 1911-1913 (Grette and Salo 1986). Since 1991, a temporary fish trap has been operated at the Diversion Dam, returns of steelhead have ranged from 30 to 150 adults. These fish are either released above the dam for natural spawning, or a select few are used to rear fry for outplanting in the upper watershed to attempt to maintain the small run. Currently, there is no established escapement goal for the upper Green River above the Diversion Dam.

3.1.4 Effects of the Proposed Project. The combined mitigation and restoration features of the AWS project and the Tacoma Mitigation Agreement will reconnect the upper Green River providing additional habitat that could support an adult spawner escapement of 1) 6500 coho salmon with production of 160,000 smolts; 2) 1300 winter steelhead with production of 25,000 smolts; and 3) 2300 chinook salmon with production of 890,000 smolts (*Appendix F; Section 2*). Recovery potential varies by stock, but it is assumed that even without recovery-additional production of all stocks will occur through long-term supplementation if necessary. As part of the Mitigation Agreement between Tacoma and the Muckleshoot Tribe a Fish Restoration Facility – a "naturalized" rearing facility for re-establishing salmon and steelhead in the upper Green River – is available for long-term supplementation that will maintain some level of increased adult fish production from natural reared juveniles planted in the Upper Green River. Current production plans include rearing of 500,000 coho and chinook salmon and 350,000 steelhead fingerlings. Either the natural spawned fish or supplemented fish will provide a net positive benefit in returning adult salmon and steelhead that can provide increased feeding opportunities from the Diversion Dam to the headwaters of the Green River.

Per discussion with agency and tribal biologists, it has been agreed that the Second Supply Water Right diversion of 100 cfs through June 30 is assumed as the without project condition. Since this is considered the without project condition, conceptually there should be no difference between without and with project conditions as the storage volumes are the same. However, for impact analysis purposes, the springtime storage of the additional 20,000 ac ft for M&I water supply has been modeled for the historic record (years 1964-1995) to assess impacts on off-channel rearing habitat and instream migration of chum, chinook, and coho salmon and steelhead smolts. The net effect is that improved reservoir fill and release conditions should result in no decrease or an actual minor increase in total side-channel habitat area and instream survival of emigrating chinook, coho, and steelhead smolts that originate from the upper and lower watershed areas (*Appendix F; Sections 5 and 7*). Chum salmon fry are the smallest emigrant in the lower watershed and the most likely species and lifestage that would be impacted by increased storage. Modeled results showed a small decrease in chum fry survival over the period of record.

Overall, for the lower watershed, the modeling results suggest impacts of spring refill should have a neutral to slight net benefit to salmon and steelhead habitat and survival of early lifestages. Outside of the neutral impact or potential improvements from spring refill, one possible outcome from adaptive management in Phase I is the immediate implementation of yearly storage (5 in 5 years) of the 5,000 ac ft of Section 1135 low flow augmentation water: dependent on consensus of agency, tribal, Corps and TPU staff. Per requirement of the Muckleshoot/Tacoma Mitigation Agreement, drought year storage (1 in 5 years) will continue to be used for maintaining summer and fall minimum flows (250 cfs), in non-drought years (4 in 5 years) the 5,000 ac ft is available for use at anytime and is planned to augment flows during steelhead egg incubation in June and July. This flow augmentation will probably decrease redd dewatering and increase overall steelhead egg-to-fry survival with attendant increases in adult survival.

Lastly, there are three fish habitat restoration projects planned for Phase I including 1) annual placement of 3,900 cubic yards of gravel in the Middle Green River at Flaming Geyser (dependent on sediment transport model or monitoring); 2) side-channel reconnection in the Upper Green River at Palmer that will restore up to 3.2 acres of off-channel habitat; and 3) 3.5 miles of river and stream habitat improvement in tributaries above the inundation pool (from 1,177 to 1,240 feet elevation). These three projects should provide a clear net benefit for salmon and steelhead with improved instream and off-channel habitat for areas above and below HHD.

3.1.5 Conservation Measures

Mitigation plans propose creating nearby meadows and improving adjacent forested habitats to promote shrub understory growth. The majority of bald eagle natural perch sites will be retained and in the specific areas where that is not possible, artificial perches will be erected. Food supply may shift slightly, from a current reservoir focus to an upper watershed focus, where adult salmonids will be introduced. Food supply in the reservoir may increase temporarily following each pool raise, but would be expected to decline again to near existing levels. Downstream from HHD, the food supply (spawned salmon carcasses) would likely not increase, and may slightly decrease following implementation of the Additional Water Supply Project. Food supply for bald eagles over the entire area influenced by the project (both upstream and downstream) is not expected to decline, but would instead increase as restoration efforts are taken to increase the number of adult salmon in the upper watershed (to 10,000 individuals). As a result of the proposed mitigation and restoration plans, and retention of natural perch sites, we anticipate that the bald eagle population within the sphere of influence of HHD will not be adversely affected.

3.1.6 Determination of Effect—Phase I

A determination of not likely to adversely affect is made. Mitigation measures (as described in the previous paragraphs) are expected to offset any potential adverse effects.

3.1.7 Effects of the Action—Phase II

3.1.7.1 Perches

Phase II would inundate about one half the acreage that Phase I would inundate, but would nevertheless result in the loss of additional perch trees, and widen the distance between the winter pool and the wooded shoreline. As with Phase I, perch trees in the inundation zone would be retained, and artificial perches would be erected if the number of existing perches was not adequate.

3.1.7.2 Food Supply

Although anadromous salmon would be re-established in the upper watershed in Phase I, implementation of Phase II introduces a degree of uncertainty as to the long-term viability of salmon runs in the Green River Watershed. The additional pool raise means less water enters the Green River in the spring and early summer, potentially reducing juvenile outmigrant survival, de-watering side channels and steelhead redds. This potential adverse impact has been incorporated into restoration projects, reservoir operations, and conceptual Phase II mitigation projects. Restoration features accomplished in Phase I (side channel reconnection, gravel nourishment, reconnection of the Upper Green River with fish passage, and 5,000 ac ft flow augmentation), reservoir operations tied to results of adaptive management monitoring (maximum refill rates, mimic natural hydrology, use of freshets), side channel mitigation projects designed to mitigate for modeled Phase II impacts by improving existing habitat and creating new channels (Section 8, Fish Appendix, 4-projects to mitigate for 8.4 acres), and 9,600 ac ft of summer/fall flow augmentation water will offset Phase II effects, and salmon populations are expected to remain as they were following implementation of Phase I.

With a larger reservoir, juvenile passage through the reservoir will likely take longer and could result in fewer fish reaching the passage facility. Wetlands created in Phase I will be inundated, and less area would be available for replacement of those wetlands—possibly resulting in smaller numbers of waterfowl nesting in the reservoir. These factors result in a likelihood of reduced food supply in the reservoir for bald eagles, though the reduction is expected to be negligible.

3.1.8 Conservation Measures
Conservation measures around the reservoir for Phase II would be similar in type to those implemented during Phase I, including additional sedge meadow creation, forest manipulations, snag retention and creation, and watershed stream habitat improvements. Conservation measures in the lower river would include: improvements in side channel habitat (habitat quality improvements, restoration of relic side channels), continued additions of gravel and large woody debris, spring-reservoir releases adaptively managed to protect important salmonid life-stages (based on monitoring results), and storage and release of 9,600 ac ft for optimal rearing and spawning flows in the summer and early fall.

3.1.9 Determination of Effect—Phase II
Implementation of Phase II of the HHD Additional Water Supply project is not likely to adversely affect bald eagles.

3.2 Northern Spotted Owl

3.2.1 Habitat Requirements/Population Status
The northern spotted owl (*Strix occidentalis caurina*) was federally listed as threatened throughout its range on July 23, 1990. Spotted owls can be found throughout the west slope of the Washington Cascades below elevations of 4,200 feet. Preferred owl habitat is composed of closed-canopy coniferous forests with multi-layered, multi-species canopies dominated by mature and/or old-growth trees (Federal Northern Spotted Owl Recovery Plan). Habitat characteristics include moderate to high canopy closure (60-80%); large (>30" dbh) overstory trees; substantial amounts of standing snags, in-stand decadence,

and coarse woody debris of various sizes and decay classes scattered on the forest floor (Gore et al. 1987, Mulder et al. 1989, Thomas et al. 1990 and others).

Owls do not build their own nests but rely on naturally occurring nest sites, such as broken top trees and cavities. In western Washington, spotted owls nest most often in cavities of trees with a dbh greater than 20 inches. In fact, there is much evidence that spotted owls require old-growth forests for reproduction; Forsman, et al (1987) (in FR, June 23, 1989) "found that 1282 [of 1502 owl observations] were in old-growth, 22 in mature forest, 131 in old-growth/mature forest, and 67 in stands less than 100 years of age, demonstrating an overwhelming preference for old growth."

3.2.2 Known Occurrences in the Project Vicinity

In 1989 and 1990, a single spotted owl was detected in the Charley Creek drainage, approximately one mile from the reservoir. This detection prompted the Washington Department of Natural Resources (DNR) to conduct a formal spotted owl survey from 1992-1994. The survey did not find any further spotted owl activity within the Charley Creek drainage, nor within a 1.8 mile radius of the project reference center as designated in the 1992 survey (site #204, reference #8759). The absence of owl activity within the consecutive three year study period by DNR satisfies the USFWS survey guidelines (March 7, 1991) for arriving at the determination that spotted owls do not exist in the project vicinity. In addition, spotted owl surveys by DNR not only resulted in no detections of spotted owls, but in numerous detections of barred owls (*Strix varia*), a species that successfully competes against spotted owls in young and mid-age forests. The abundance of barred owls in the watershed is further evidence that the forests there are not ideal spotted owl habitats.

3.2.3 Effects of the Action

Suitable spotted owl habitat within the project area is limited due to extensive recent logging activities. The Federal Register (June 23, 1989) points out that recorded home range sizes used by adult spotted owls vary from 300 acres to more than 19,000 acres. Ecological theory suggests that the 300 acre home range(s) as likely ideal habitat, requiring little foraging effort, while the 19,000 acre home range would certainly be marginal habitat, as the pair was required to search far and wide for food. The mature conifer forests in the project area are fragmented and small in total area--only 49 acres of the 627 acre project area were mapped during vegetation mapping for the project; the larger proportion of forest in the project area is deciduous forest and mixed deciduous and coniferous forest. The suitable habitat at the project area is not only too small, it is also not quite old enough to be truly good spotted owl nesting habitat. Findings from the 1995 City of Tacoma Green River Watershed stand inventory (Ryan, 1995) indicate that 40% of the total acres (9,375 acres) of deciduous and coniferous forests are between the ages of 70-80 yrs., forests less than 70 yrs. comprise 50% of the total acreage and forests greater than 80 yrs. make up 10% of the acreage. These calculations take into account all land owned by Tacoma within the watershed; not just the land adjacent to the reservoir. The age class breakdown is still the same for the land within 1/4 mile of the reservoir, however, with the only difference being that the greatest percentage of trees within this area are between 60-70 yrs. of age rather than 70-80 yrs. (Ryan, personal comm., 1996). Fourteen acres of this "mature" conifer forest would be inundated in Phase I, and another 6 acres would be inundated in Phase II.

The upper end of the inundation zone was logged 15-20 years ago and the lower end of the reservoir along Charley Creek and the North Fork was logged 1-10 years ago. Thus, much of the vertical structure required for nesting (in the form of large limbs and tree crotches) is still lacking and there are few fallen and decayed logs that might support prey species.

Lack of suitable spotted owl habitat, coupled with the DNR and Corps survey information (see section 3.2.2) provide a reliable assurance that the habitat within the project area is not critical to spotted owl survival. Loss of approximately 20 acres (total in both Phase I and II) of nearly mature coniferous forest (and about 311 acres of mixed and deciduous forest) is thus not expected to adversely affect spotted owls in this region.

3.2.4 Conservation Measures
Because spotted owls are not present in the area and suitable habitat does not exist, no conservation measures are indicated at this time. Nevertheless, some of the mitigation measures to be undertaken are intended to accelerate the maturation process of forest stands, through the creation of openings in the forest canopy, supplementation of large woody debris, and creation of snags.

3.2.5 Determination of Effect
A determination of not likely to adversely affect is made for both Phase I and Phase II.

3.3 Marbled Murrelet

3.3.1 Habitat Requirements/Population Status
The marbled murrelet (*Brachyramphus marmoratus marmoratus*) was officially listed as a threatened species on October 1, 1992. Murrelets inhabit shallow marine waters and, like spotted owls, nest in mature and old-growth forests. All nest locations in Washington have been located in old-growth trees that were greater than 32 inches in diameter at breast height (dbh) (USFWS Planning Aid Report, 1994). Nest stand characteristics generally include a second story of the forest canopy that reaches or exceeds the height of the nest limb, thereby providing a protective enclosure surrounding the nest site. A single, large, closed-crowned tree, which provides its own protective cover over the nest site may also be used by murrelets (USFWS, 1993). Large, moss-covered limbs in tall trees are utilized for egg-laying. Marbled murrelet nests have been located in stands as small as approximately seven acres (Hamer and Nelson, 1995) and are generally within 50 miles of marine waters. In Washington State, marbled murrelet abundance was found to be highest in areas where old-growth/mature forest comprised more than 30 percent of the landscape.

3.3.2 Known Occurrences in the Project Vicinity

Available information suggests that the habitats around HHD are marginal for marbled murrelet nesting (Ritchie, 1994). Reasons for this determination include that fact that HHD is approximately 30-40 miles from Puget Sound; and few large trees exist in the project area. The primary factor that may be limiting in the project area is the availability of moss-covered branches. Marshall (1988) reports that moss does not grow on Douglas fir trees until the trees are 150 years old. In Oregon, it is reported that a seral stage of coniferous forest called "mature" begins at 80 years of age and continues to about 175 years, when it becomes "old growth" (Marshall, 1988). Thus, as the forest in the project area is still relatively young (70-80 yrs. old), few branches of sufficient size for murrelet nesting exist. However, western hemlocks of relatively young age (70-100 yrs.) do have moss-covered branches; but these trees are few and in only three scattered locations of less than an acre each. To date, no marbled murrelet nest has been found in a stand size of less than 7 acres (U.S. Forest Service, 1996; Hamer and Nelson, 1995). Another limiting factor may also be the fragmentation of conifer forests in the project area; it may be that marbled murrelets require large, unbroken stands of conifer forests. Murrelet detections have been found to increase in areas where old-growth and mature habitat comprise over 30 percent of the landscape and decline when clear-cut and open meadow habitat occur over 25 percent of the landscape (Hamer and Cummins 1990). Marshall (1988) reports that:

> "the species' reliance on old-growth or trees nearing old-growth status is based on: (1) All nests found in coniferous forest biomes were in trees representing old-growth characteristics; (2) downy young have been found only in old-growth forests and fledglings in or near old-growth; (3) inland observations of adult marbled murrelets are associated with old-growth and mature forests; and (4) during the nesting season, marbled murrelets occur mainly offshore opposite old-growth or mature forest stands in the southern parts of their range."

A query of the WDFWS Priority Habitats and Species (PHS) database in December 1995 revealed no record of any known marbled murrelet activity in the vicinity of the reservoir. During 1994, marbled murrelet surveys were conducted following protocol developed by the Pacific Seabird Group (Ralph et al. 1994). The surveys were conducted in the reservoir area within three stands identified by Bill Ritchie (WDFWS), Tim Bodurtha (USFWS) and Ken Brunner (Corps) as marginally suitable for murrelet nesting. Bill Ritchie recommended that only a one-year survey would suffice--just to be sure no murrelets were in the area--based on his observations that: 1) there was no suitable murrelet nesting habitat within several miles of the three isolated stands; 2) none of the stands are greater than one acre in size; and 3) there are very few potential perches in the three stands (one of the "stands" only has one tree of sufficient size); and 4) no other murrelets had been detected in the Green River watershed, making these marginal sites even less likely to be occupied. Thus, only one year of survey was conducted. No marbled murrelets were detected during the survey. Marbled murrelet surveys were also conducted in a five to ten acre stand located north of the Tacoma Diversion Headworks Dam in 1994 and 1995, also following murrelet survey protocol. This stand supported approximately four to six conifers per acre that were larger than 50 inches dbh, with several trees supporting moss covered branches and limbs at least seven inches in diameter. No marbled murrelet activity was detected during either survey year (Beak 1994; Beak 1995). Numerous murrelet surveys have also been conducted over the past three years by timberland owners and the U.S. Forest Service (USFS) in the upper Green River drainage and the Huckleberry ridge area. No detections have been recorded during these surveys.

3.3.3 Effects of the Action

Based on the surveys conducted in 1994 and 1995, no marbled murrelets occur within the project vicinity. Potential marbled murrelet habitat is lacking, as the coniferous forest in the project area is generally 60-80 years of age. There is no old-growth forest in the project vicinity; and only a few trees with suitable nest-site characteristics exist in the reservoir area. In particular, within the inundation zone of Phase I is one small stand with about one acre of suitable nest trees. No other potential nest stand is within the inundation zone. Clearly, because of the relatively young age of most of the trees in the reservoir vicinity, murrelets are not likely to nest in the project area now; however, given Tacoma's plan to retain the forests intact, combined with the mitigation measures aimed at advancing the succession of certain forest stands, marbled murrelets may nest in the project vicinity in the future. The proposed pool raise and consequent loss of forested habitat is not expected to adversely affect marbled murrelets, especially as forest management will lead to stands that provide the necessary structure for murrelet nesting, although it is expected that appropriate nesting structure in the project vicinity will take many years to develop.

3.3.4 Conservation Measures

None indicated at this time.

3.3.5 Determination of Effect

The proposed pool raise is not likely to adversely affect marbled murrelets in either Phase I or Phase II.

3.4 Gray Wolves

3.4.1 Habitat Requirements/Population Status

The gray wolf (*Canis lupus*) is listed as an endangered species in Washington State and can utilize a broad spectrum of habitats, as long as they include an abundance of prey (generally ungulates), suitable denning and rendezvous sites, as well as areas away from human disturbance (USFWS, 1995). The availability of prey may be the primary factor in determining habitat suitability (Stevens and Lofts, 1988). Den sites are most commonly burrows in sandy soils, but can be located in a variety of settings, from downed logs and hollow trees to rock caves. Rendezvous sites tend to be near a source of open water in small meadows with limited visibility.

3.4.2 Known Occurrences in the Project Vicinity

No gray wolves have been observed in the reservoir area. The closest known surveys to be conducted for gray wolves have been in selected areas on Huckleberry Ridge between the Green River and White River drainages in 1993. During those surveys, no wolves were heard and evidence of wolf use of the area was not observed.

3.4.3 Effects of the Action

None.

3.4.4 Conservation Measures

As gray wolf habitat will not be impacted, no conservation measures are indicated at this time.

3.4.5 Determination of Effect

The project would not likely to adversely affect gray wolves in either Phase I or Phase II.

3.5 Grizzly Bears

3.5.1 Habitat Requirements/Population Status

The grizzly bear (*Ursus arctos*) is a federally-listed threatened species. It is not closely associated with late-successional forests, but inhabits vast areas of diverse habitat types, including alpine meadows. The presence of an abundance of berries, fish and other food is necessary to support these large omnivores. Other items include mountain goat, deer, and elk. Grizzly bears have large home ranges of up to 1,004 square miles. They usually move down to lower elevations after emerging from their high elevation denning areas in the spring. Most often, grizzly bears are found in remote areas where human activity is limited and roads are few or closed to access, especially to hunting.

3.5.2 Known Occurrences in the Project Vicinity

No grizzly bears or sign of grizzly bears have been reported in the Howard Hanson Reservoir area. However, in 1993, the WDFW verified tracks of grizzly adult, cub and an unknown aged bear near Kapowsin, Pierce County. No other sightings of grizzly bear have been documented for this area.

3.5.3 Effects of the Action

None.

3.5.4 Conservation Measures

As grizzly bear habitat will not be impacted, no conservation measures are indicated at this time.

3.5.5 Determination of Effect

The project would not likely adversely affect grizzly bears in either Phase I or Phase II.

3.6. Spotted Frog

3.6.1 Habitat Requirements/Population Status

The spotted frog (*Rana pretiosa*) is listed as a candidate species in Washington State. The frog populations have declined dramatically in western Washington and Oregon. In Washington, the species is known to occur at several locations east of the Cascades (Leonard et. al 1993). It is believed that the non-native bullfrog (*Rana catesbeiana*) and other aquatic predators have seriously reduced these populations. Adult spotted frogs are found in or near perennial water bodies such as springs, ponds, lakes, or slow moving streams and are often associated with emergent, non-woody vegetation (Leonard et. al 1993). It is rare to find a spotted frog more than one meter away from water and they tend to sit in the shallows, half submerged, or they float in deeper water, clinging to aquatic vegetation with their head visible. Spotted frogs eat invertebrates, and adults can eat other small frogs (Light 1986a).

3.6.2 Known Occurrences in the Project Vicinity

The project area lies within the historic range of the spotted frog. Sightings in Thurston County are the only confirmed observations of spotted frogs in 23 years in western Washington lowlands.. Within the project area, perennial water sources with adjacent emergent vegetation could provide suitable spotted frog habitat. Nevertheless, due to the rare documented occurrence of the spotted frog in western Washington lowlands, the spotted frog is not expected to occur in the project area.

3.6.3 Effects of the Action

Spotted frogs are not known to exist in the reservoir area and thus would not be directly impacted by the pool raise. Potential spotted frog habitat may be displaced, however.

3.6.4 Conservation Measures

Wildlife habitat restoration opportunities investigated for this project which would benefit spotted frogs are the creation of sub-impoundments for amphibians and the establishment of additional vegetation in the drawdown zone. Sub-impoundments are designed to flood during high reservoir pool elevations and maintain surface water by containment during reservoir drawdown. Sub-impoundments offer an increase in habitat by trapping and holding water for a longer period of time and by making open water habitat for amphibians available for longer periods after reservoir drawdown.

3.6.5 Determination of Effect

If spotted frogs occur within the project area, they may initially be displaced from suitable habitat during reservoir inundation. However, spotted frogs are not expected to occur in the project area as they have only been reported at one site in western Washington lowlands over the past 23 years. The project is not likely to affect spotted frogs in either Phase I or Phase II.

3.7 Bull Trout

3.7.1 Habitat Requirements/Population Status

The bull trout (*Salvelinus confluentus*) is listed as a candidate species in Washington State. It is found in interior and some coastal drainages from northern California to southeast Alaska (Stolz and Schnell, 1991). It is estimated that at least 77 distinct populations of bull trout exist in the state of Washington (WDW, 1992) Bull trout in the Puget Sound region and coastal streams are anadromous. Groundwater influence and proximity to cover are reported as important factors in spawning site selection. Bull trout characteristically occupy high quality habitat, often in less disturbed portions of a drainage. Necessary key habitat features include channel stability, clean spawning substrate, abundant and complex cover, cold temperatures, and lack of barriers which inhibit movement and habitat connectivity (Reiman and McIntyre, 1993).

3.7.2 Known Occurrences in the Project Vicinity

Historically, bull trout were found in the thousands in the middle Green (RM 35) (Grette and Salo, 1985). Their occurrence in the upper Green River has not been verified. The U.S. Forest Service conducted recent surveys in the upper Green River drainage and several tributaries (Sunday Creek and Pioneer Creek) and found no evidence of bull trout (Goetz, pers. comm., 1996). Plum Creek has also completed surveys in other upper Green River tributaries with no verification of bull trout presence (Plum Creek Watershed Analysis and Steve Toth, pers. comm. 1995). The habitat in these areas was considered somewhat degraded due to past timber harvests. Stream temperatures in the survey area may also be warmer than temperatures required by bull trout in the late summer (Goetz, 1989 and 1994).. Bull trout were reported in the Green River in 1964 and in the Duwamish in 1994 (E. Warner, pers. comm.)

3.7.3 Effects of the Action

Raising of the reservoir is not expected to affect bull trout as use of this reach by bull trout has not been proven. However, char (genus *Salvelinus*) have been documented in Page Mill Creek and are presumed to be brook trout (*S. fontinalis*) (Wunderlich and Toal, 1992). In order to verify this, a presence and absence survey in Page Mill Creek will be conducted by 1998. If bull trout do occur in the upper Green River watershed, they could utilize the mainstem for spawning, but spawning typically occurs in low gradient areas of cold water (<9-12 C) and in second to fourth order streams (approximately 20 to 50 cubic feet per second) (Goetz, 1994). Although Page Mill Creek is the only likely spawning area within the project that meets all habitat suitability requirements, this stream has been so extensively modified by logging, development, and establishment by brook trout, that bull trout, if historically present, were extirpated long ago. If bull trout are present in the upper Green River watershed they could utilize portions of the reservoir for rearing.

3.7.4 Conservation Measures

If bull trout existed in the project area, and their spawning habitat was outside the project, they would benefit from fisheries enhancement associated with the project. Fish passage will be improved along the entire length of Page Mill Creek, large woody debris will be placed in the lower reaches of the reservoir tributaries, riparian vegetation will be added and a more defined stream channel for Gale Creek in the upper reservoir will be established. Floating islands of large woody debris may also be designed to provide in-reservoir cover.

3.7.5 Determination of Effect

Presently, there is no documented use of the mainstem Green River or major tributaries by bull trout. Raising of the reservoir level in either Phase I or Phase II should not adversely affect bull trout, as no documented observations of bull trout have been made in the area.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
North Pacific Coast Ecoregion
Western Washington Office
510 Desmond Drive SE, Suite 102
Lacey, Washington 98503
Phone: (360) 753-9440 Fax: (360) 753-9008

January 28, 1998

Colonel James M. Rigsby
District Engineer
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124-2255
Attention: Ken Brunner

Re: Howard Hanson Biological Assessment
FWS Ref: 1-3-98-I-0021

Dear Colonel Rigsby:

This letter is in response to your Biological Assessment (BA) for the Howard Hanson Additional Water Storage Project, dated January 15, 1998, and received by us via email on the same day. The BA, along with the information provided by phone by your staff on January 7 and 8, 1998, now provides sufficient detail on the project's design and operation for us to complete our review. We received an earlier version of the Corps of Engineers ' (Corps) BA on October 21, 1997, but could not complete our review because the project design was still evolving.

The Corps determined that the proposed Howard Hanson Additional Water Storage Project would not likely adversely affect the bald eagle (*Haliaeetus leucocephalus*), northern spotted owl *(Strix occidentalis caurina*), marbled murrelet (*Brachyramphus marmoratus marmoratus*), gray wolf (*Canis lupus*) and grizzly bear (*Ursus arctos*). The U. S. Fish and Wildlife Service (Service) concurs with your determination.

The Service's concurrence is based upon: (1) the implementation of the conservation measures described in the BA; (2) the Corps' statement that phase 2 of the project (conservation pool raise to elevation 1,177 feet, MSL) will not be implemented until it is demonstrated that this action will not adversely affect the Green River's salmon and steelhead resources; and (3) the retention of all merchantable and large trees within the larger conservation pool unless logging can be accomplished without adversely impacting the restoration of the anadromous fish runs upstream of the project.

This concludes informal consultation pursuant to Section 7(a)(2) of the Endangered Species Act of 1973, as amended. This project should be re-analyzed if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation; if the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat this was not considered in this consultation; and/or if a new species is listed or critical habitat is designated that may be affected by this project.

If you have further questions about this letter or your responsibilities under the Act, please contact Gwill Ging at (360) 753-6041.

Sincerely,

Nancy J. Gloman

Nancy J. Gloman
Acting Supervisor

gg/jmc
c: NMFS, Lacey
WDFW, Olympia
WDFW, Mill Creek
Muckleshoot Indian Tribe

Brunner
McNeely

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO
ATTENTION OF

Technical Services Branch

Mr. Steven Landino
National Marine Fisheries Service
510 Desmond Dr., Suite 103
Lacey, Washington 98503-1273

MAY 26 1998

Dear Mr. Landino:

The Corps of Engineers, in partnership with the City of Tacoma Water Division is planning to raise the elevation of the reservoir behind Howard Hanson Dam, on the Green River, Washington, in order to provide additional municipal water supply, as well as to provide low flow augmentation for fish in the Green River below the dam. A second project purpose is ecosystem restoration, with a goal of restoring anadromous fish runs to the upper Green River above Howard Hanson Dam. The project would be implemented in two phases: Phase 1 would begin in 2004, while Phase 2 is dependent upon monitoring and evaluation, and agency concurrence that impacts to anadromous fish would be minimal. This letter transmits a biological assessment (BA) that addresses the effects of the project on the proposed Puget Sound chinook salmon ESU (*Oncorhynchus tshawytscha*), as well as on two candidate species: Puget Sound coho (*O. kisutch*), and sea-run cutthroat (*O. clarki clarki*).

The BA concludes that Phase 1 of the proposed action is not likely to jeopardize the continued existence of the chinook salmon in the Green River, and is not likely to adversely affect coho or sea-run cutthroat. These determinations are based on project impacts as well as implementation of restoration measures in Phase 1. In order to offset certain project effects, we will implement mitigation measures in addition to restoration measures.

If you have any questions, or wish to discuss project details, please call Mr. Fred Goetz at (206) 764-3515, or Mr. Ken Brunner at (206) 764-3479.

Sincerely yours,

S. Martin for
Cyrus M. McNeely
Chief, Environmental Resources Section

cf:
Fransen
Poon

cc:
Goetz (ED-TB-ER)
Brunner (ED-TB-ER)
McNeely (ED-TB-ER)
Loll (PM-CP)
Hickey (Tacoma Water Division)

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO
ATTENTION OF

CENWS-ED-TB-ER

Mr. William Stelle, Jr., Director
National Marine Fisheries Service
Northwest Regional Office
7600 Sand Point Way NE
Building #1
Seattle, Washington 98115-0070

Dear Mr. Stelle:

The Seattle District Corps of Engineers needs to be expeditious in proceeding with the Howard Hanson Dam Additional Water Storage (HHD AWS) study, an effort which will result in a project of considerable potential benefit to the population status of wild salmonids in the Green River basin. Accordingly, I would like to ask your prompt acceptance of our plan to not include the biological assessment (BA) that we will prepare to consider impacts on the Puget Sound ESU of chinook salmon, recently proposed as threatened, in the draft EIS. The reasons for proceeding in this manner are set forth below. We have appreciated and benefited from the timeliness you and your staff have previously extended to the Corps and our sponsor, the City of Tacoma, in our coordination and correspondence (enclosure). I hope for the same courtesy in our current request.

We recently completed a Section 7 consultation process with the U.S. Fish and Wildlife Service for species under their purview. Until your proposal on March 10, 1998, there had been no anadromous fish proposed or listed that could be affected by the HHD AWS project. The recent proposal of Puget Sound chinook comes at a time when we are under a strict schedule to complete the draft feasibility report and environmental impact statement (DFR/EIS). The DFR/EIS is scheduled to be mailed for public comment on April 13. This tight schedule leaves us insufficient time to request a species list from you, prepare a biological assessment (BA), receive your concurrence, and include all of the above in the DFR/EIS. To inform reviewers, we would indicate in the DFR/EIS that the Section 7 process for Puget Sound chinook salmon is in process and would be completed prior to finalizing the DFR/EIS. Although the BA would not be included in the draft DFR/EIS for public review, we believe this would be acceptable because we think we have a good understanding of the issues as a result of extensive coordination with you and your staff, and because we have thoroughly addressed the issues in our previous correspondence, as well as in the DFR/EIS. Indeed, our project planning is largely dedicated to the continued existence and improvement in population status of wild salmonids in the Green River system, and we believe that, with implementation of the HHD AWS project, there will be renewed hope for protection and recovery of wild salmonids in the Green River basin.

We understand that for a proposed species, our determination will be in the form of "jeopardy" or "no jeopardy", and that your concurrence is not required in the case of proposed species. However, since our project would not be constructed until 2001, the chinook may well be listed prior to completion of our project. We understand that the Section 7 coordination process will need to be reinitiated prior to commencement of construction of the project. As such, your opinion of the effect of our project on Puget Sound chinook would be appreciated, to give us an early indication on the direction our project should take. Your opinion will be solicited with the transmittal of our BA.

Accordingly, I am requesting your agreement with our proposal to prepare the BA concurrently with public review of the DFR/EIS, and complete the Section 7 process before we finalize the DFR/EIS. I would appreciate receiving this concurrence by March 31, 1998.

If you would like to discuss this issue with us, please contact me at (206) 764-3624. I or my staff will be happy to address any concerns you may have on this issue.

Sincerely yours,

J. Steven Foster
Chief, Civil Projects and Planning Branch

enclosure

cf:
Landino
Fransen
Poone

HOWARD HANSON DAM ADDITIONAL WATER STORAGE PROJECT
BIOLOGICAL ASSESSMENT
MAY 22, 1998

1.0 BACKGROUND

The city of Tacoma (Tacoma Public Utilities (TPU), Washington receives a majority of its municipal and industrial water supply from the Green River through their diversion structure at river mile (RM) 61.0. The Howard A. Hanson Dam (HHD), a U.S. Army Corps of Engineers dam, is located within the City of Tacoma's watershed on the upper reach of the Green River, at RM 64.5. HHD provides winter flood control and summer low flow augmentation (LFA). The reservoir behind HHD has never been filled to its authorized elevation of 1206 feet, but maintains an established conservation pool elevation of 1141 feet[1] during spring and early summer for fishery low-flow augmentation, until inflow can no longer keep up with outflow, at which point the reservoir slowly drains to its winter minimum of approximately 1070 feet.

At present, the Corps stores approximately 25,400 acre-feet (ac-ft) of water behind HHD for downstream LFA during the summer and fall. An additional 5,000 ac-ft of water for LFA is authorized through a Section 1135 restoration project. Tacoma presently diverts 113 cubic feet per second (cfs) of water, at their diversion dam, to provide M&I water to Tacoma under their first diversion water right (FDWR). Tacoma is also authorized to divert 100 cfs of M&I water under its Second Supply Water Right (SSWR). This 100 cfs SSWR is conditioned by the Tacoma Public Utilities/ Muckleshoot Indian Tribe (TPU/MIT) Agreement, which establishes minimum in-stream flows for the Green River through each calendar year. These flows exceed the current state established minimum flows.

Tacoma recognizes the need for an additional water supply, especially during the summer months, not only because of the high water demand during this time of the year, but also because natural flow withdrawals are constrained to protect fish. The existing storage is entirely dedicated to fish needs and therefore not available to Tacoma. A certified reconnaissance study completed by the U.S. Army Corps of Engineers determined that additional water storage behind HHD is the most viable source of municipal and industrial water supply for Tacoma and its service area. Under the Additional Water Storage (AWS) project, the conservation pool would be increased in two phases: the first phase would increase the annual conservation (summer) pool elevation by 20 feet, from 1147 feet[1] to an elevation of 1167 feet storing Second Supply Water and implement a series of restoration projects. The second phase (which would occur at least five years after implementation of Phase I) would raise the summer conservation pool an additional

[1] The existing summer conservation pool maintains an elevation of 1141 ft, beginning in the year 2000 a follow-on restoration project (HHD Section 1135) will store an additional 5,000 ac ft for flow augmentation raising the summer conservation pool to 1147 ft.

10 feet to elevation 1177 feet. Implementation of Phase II is dependent on results of Phase I restoration projects, ability to minimize impacts to lower river habitat from storing additional water, and concurrence of agency and tribal biologists. Both of these pool raises results in loss of terrestrial and wetland habitat adjacent to the existing reservoir; the project also results in downstream in-stream effects, particularly during Phase II.

Restoration of anadromous fish to the Upper Green River is the keystone of the AWS project ecosystem restoration. Phase I of the AWS project includes construction of a downstream fish passage through HHD, resulting in the re-introduction of anadromous salmonids to the upper watershed: the City of Tacoma will have concurrently completed an a fish ladder and upstream truck and haul project to pass adult salmon and steelhead around both dams. Three habitat restoration projects will also be implemented in Phase I these include annual placement of 3,900 cu yd of gravel in the Middle Green River, restoration and reconnection of a ¾ mile long side channel at RM 58-59, and improvement of large tributary habitat above the Phase II inundation pool. The inclusion of these restoration features -- improved fish passage, increased instream flows, and fish and wildlife habitat -- provides a historic opportunity to restore and maintain self-sustaining and harvestable runs of salmon and steelhead for the Green River. The phased implementation and adaptive management measures proposed for the project allow for the flexibility to make adjustments to ensure the protection of fish and wildlife.

The U.S. Fish and Wildlife Service (USFWS) in a letter dated January 22, 1996 identified five federally listed animal species and two candidate species which may occur in the project vicinity. Included in this list were bald eagles (*Haliaeetus leucocephalus*), marbled murrelets (*Brachyramphus marmoratus marmoratus*), northern spotted owls (*Strix occidentalis caurina*), gray wolves (*Canis lupus*) and grizzly bears (*Ursus arctos*). Spotted frogs (*Rana pretiosa*) and bull trout (*Salvelinus confluentus*) were listed as candidates (with 15 other species; in a Notice of Review on February 28, 1996, the USFWS dropped many species from the candidate list; for the HHD project, only the bull trout and spotted frog remain as candidate species). The potential impacts to these listed and candidate species as a result of the Howard Hanson reservoir inundation project are outlined in the January 15, 1998, biological assessment (BA) found in Appendix H of the HHD AWS Draft Feasibility Report (FR) and EIS.

Since submittal of the January 15, 1998, BA, National Marine Fisheries Service (NMFS) has proposed listing Puget Sound chinook salmon (*Oncorhynchus tshawytscha)* as a threatened species. Natural spawning chinook salmon occur below the project and can be affected by reservoir operations while hatchery chinook salmon are released above the project and could continue to be stocked as part of a basin recovery effort if the AWS project proceeds. Puget Sound coho salmon (*O. kisutch*) and sea-run coastal cutthroat (*O. clarki clarki*) are also listed as candidate species and both are found below and within the project area. The potential impacts to these proposed and candidate anadromous fish species are outlined in this May 22, 1998, biological assessment and will be included in

Appendix I of the HHD AWS Final FR/EIS. The discussion of bald eagle effects is retained in this BA, as much of that discussion pertains to impacts to anadromous fish.

2.0 BASELINE CONDITION AND GENERAL PROJECT IMPACTS

The baseline condition for this project includes conditions as a result of all current operating projects and facilities. These include: 1) the existing HHD project, which is used for flood control during the late fall and winter and for spring storage of 25,400 ac-ft of water for summer LFA; 2) the HHD Section 1135 Fish and Wildlife Restoration Project, which authorizes storage of an additional 5,000 ac-ft of water for LFA, a "without project" feature; 3) TPU's Pipeline Projects, Pipeline No. 1 (P1), which was constructed to carry Tacoma's FDWR, and 4) Pipeline No. 5 or the Second Supply Water Right (P5 or SSWR), which will carry TPU's SSWR. TPU was granted a permit, under Section 404 of the Clean Water Act, to construct P5. Construction is scheduled to be complete by 2003, before the HHD AWS project is scheduled to be implemented, this is a "without-project" feature. Impacts resulting from Tacoma's P1 and P5 projects have already been mitigated for or are being considered for Endangered Species Act compliance through a Habitat Conservation Plan (HCP) that Tacoma is currently pursuing: contact Paul Hickey or John Kirner at TPU for further information.

Phase I of the AWS project would result in the inundation of about 325 acres of terrestrial and wetland habitats (including 79 acres of riparian and 11.5 acres of stream habitat), while Phase II would inundate an additional 153 acres of habitat (42 acres riparian and 5.9 acres stream). Most plants in the inundation zones would die during the first season of inundation, although a few species of plants that are more tolerant of inundation would survive for a longer period than species intolerant of inundation. The City of Tacoma would like to remove some merchantable timber from the inundation zone, and leave the remainder of trees. This point is currently being debated by resource agencies, who would prefer to see no trees cut from the inundation zone, in order to provide habitat for juvenile salmonids. The project is currently described as leaving all trees flooded by the new inundation pool(s). In the event that merchantable trees are cut, the Corps of Engineers and the City of Tacoma will inventory the inundation zone and designate particular trees which are not to be cut, even in the merchantable areas. The Corps would amend this BA and transmit it to NMFS for concurrence. In addition, to insure that suitable perches will be maintained for raptors, dead snags would be retained and allowed to fall as they rot.

As related to anadromous fish, five adverse impacts were identified under the AWSP feasibility study resulting from storing 20,000 ac ft of the SSWR in Phase I and 32,000 ac-ft of additional storage (beyond the SSWR) in Phase II during the winter and spring. These impacts are found in two distinct areas: 1) within the HHD project boundary, at the dam and within the reservoir; and 2) in the lower watershed, from HHD to the estuary. The impacts within the project boundary from increased pool size in Phase I and II are: 1) potential decreased survival of a proportion of juvenile salmon and steelhead migrating through the larger pool, and 2) stream and riparian habitat inundated by the pool raise. The phased nature of the AWS project presumes there will are no impacts to the lower watershed during Phase I spring refill since Phase I storage uses water (SSWR) that Tacoma would have otherwise have diverted from the mainstem river between February and June. The impacts from Phase II additional storage (32,000 ac ft) in the lower watershed from spring refill are: 1) dewatering of steelhead eggs, 2) reduced survival of outmigrating juvenile salmon and steelhead, and 3) disconnection of side-channel habitat from the mainstem river.

The AWS project includes Ecosystem Restoration as a project purpose. A series of aquatic habitat limiting factors have been identified in the Green/Duwamish Basin that the AWS project could address which include 1) reconnection of the Upper and Lower Green River with fish passage over and/or through the Tacoma Diversion Dam and HHD; 2) low flows during summer and fall; 3) water temperatures that exceed state water quality standards; 4) lack of large woody debris in tributary and mainstem areas; and 5) reduction of peak flows with reduced sediment transport. Phase I includes a series of restoration projects (habitat improvement <u>beyond</u> mitigation requirements) that address part(s) of each of these limiting factors including:

1. <u>Downstream Fish Passage.</u> A new intake tower with new fish collection and transport facility (capable of passing up to 1250 cfs within NMFS screening criteria) would be built including: a wet-well, a floating fish collector, a fish lock, a discharge conduit, a fish transport pipeline and monitoring equipment. The facility will be adaptively managed based project monitoring and evaluation: a 15 year of reservoir and dam monitoring program is proposed (see *Appendix F, Part One, Section 10*). Upstream fish passage will be provided by TPU with a truck and haul facility at the barrier dam beginning in 2003. One objective of the fish passage project would be to boost the natural spawning adult salmon and steelhead population to up to 10,000 individuals within 20 years (estimated total escapement used for planning purposes; *Appendix F, Part One, Section 2*).
2. <u>Low Flow Augmentation.</u> Phase I provides for yearly storage of the 5,000 ac ft under the HHD Section 1135 project. Phase II provides an additional 9,600 ac ft of storage dedicated for low flow augmentation (LFA). Flow modeling suggests we have an 80% annual reliability of achieving storage of the combined 14,600 ac ft from both storage accounts.
3. <u>High Water Temperatures.</u> The new fish passage facility surface outlet allows blending of surface and deep-water releases which will ameliorate existing high temperatures resulting from dam discharges. Outflow releases will track the natural ambient rise and fall of seasonal temperature change. In the lower river, LFA can provide increased flow volume and velocities that can improve near-shore temperatures and intergravel flow.
4. <u>Lack of Large Woody Debris</u>. Habitat improvements above HHD include addition of large woody debris to mainstem and large tributaries of HH Reservoir extending from the Phase II summer pool elevation (1177 ft) up to 1240 ft elevation. Below HHD the Corps is proposing to truck and release at RM 59 an underdetermined number of

pieces of large wood collected out of HH Reservoir. Lastly, a ¾ mile long side-channel will be restored and reconnected to the mainstem between RM 58-59: several hundred pieces of large woody debris would be added to this off-channel habitat.

5. Sediment Transport. Since construction of HHD, peak flows have been reduced from 30,000 cfs to a maximum 12,000 cfs with a concurrent reduction of coarse sediment transport with storage of larger particles beyond HHD: at a rate of 3,900-11,700 cu yd/year (see *Appendix F, Part One, Section 4.b)*. This reduction in sediment transport is degrading spawning habitat (bed armoring) in the Middle Green River (RM 40-46) at a rate of 700-1,000 lineal feet of mainstem habitat per year (Fuerstenberg et al. 1996). In Phase I, annual placement of 3,900 cu yd of gravel would occur between RM 40-46 to retard the loss and maintain spawning habitat in the Middle Green.

3.0 PROJECT IMPACTS ON LISTED SPECIES

The National Marine Fisheries Service (NMFS) checklist for documenting environmental baseline conditions and effects of proposed actions on relevant environmental indicators was used to help assess the effects of the HHD AWS project on anadromous salmonid habitat. The NMFS checklist was applied to three areas of the Green River affected by the AWS project and is presented in Table 1.

Anadromous salmonids historically were found throughout the upper Green River watershed (221-231 square miles of the 483 square mile basin) and were probably a more important food source for bald eagles prior to construction of the Tacoma Diversion Dam (RM 61) and HHD (RM 64.5) than they are now. The dams blocked upstream passage of adult salmon, steelhead, and probably sea-run cutthroat trout and ended spawning in at least 106 accessible stream miles above the dams. Various authors have estimated that over 30,000 adult salmon and steelhead could be produced in the watershed above the dams (*Appendix F, Part One, Section 2*). From 1911-1914, a weir and egg take station was used to capture broodstock and establish hatchery runs of steelhead, coho and chinook salmon to compensate for the loss of spawning habitat above the Diversion Dam, with trap counts maintained for coho and steelhead. The average return for coho during those years was 5600 adults while steelhead was 1600 adults. Grette and Salo (1986) reported that historical production ranged from 9,000-25,000 for coho, 500-5200 for steelhead, and from 150 to 300 for spring chinook. The authors researched Washington Department of Game records and concluded that harvest and seasonal blockages below the trap could have resulted in underestimates of total returns. In 1929, an anonymous author for the Washington Dept of Game said that the upper watershed above the Tacoma Diversion Dam contained 90 percent of the spawning habitat in the Green River for coho salmon and steelhead (cited in Fuerstenberg et al. 1996).

At least one account indicates as many as 15 bald eagles at Eagle Gorge prior to construction of the dam(s), which may well have been because of spawning salmon at that location (Eagle Gorge is now part of the reservoir behind HHD). The AWS project would not only result in higher reservoir levels, but would also result in altered downstream flows. The issues surrounding flows in the Green River and the various stocks of salmon are complex. Because salmon have historically been important to bald eagles (and still provide eagles with a food source downstream from the dam), and because of the recent proposed listing and status review of salmon, the following discussion on bald eagle goes into some detail on the existing (baseline) condition of salmon stocks in the Green River, and the expectations following implementation of Phase I, and then Phase II, of the AWS project.

Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), cutthroat trout (*O. clarki*), and steelhead (*O. mykiss*) are the five main salmonid species supported by the Green River. In addition, char (*Salvelinus spp.*) may be found sporadically in the watershed, but there is little information to substantiate their status as a native spawning and rearing stock.

3.1 Bald Eagle

3.1.1 Habitat Requirements/Population Status

The bald eagle is listed as threatened in Washington on the Federal list of endangered, threatened, and proposed animals and plants. The bald eagle (*Haliaeetus leucocephalus*) is found only in North America and ranges over much of the continent, from the northern reaches of Alaska and Canada down to northern Mexico. Bald eagles migrate to wintering ranges in Washington State in late October and are most commonly found along lakes, rivers, marshes, or other wetland areas west of the Cascades, with an occasional occurrence in eastern Washington.

The characteristic features of bald eagle breeding habitat are nest sites, perch trees and available prey. Bald eagles primarily nest in uneven-aged, multi-storied stands with old-growth components (Anthony, et al. 1982). Factors such as tree height, diameter, tree species, position on the surrounding topography, distance from water, and distance from disturbance also influence nest selection. Live, mature trees with deformed tops are often selected for nesting and nests are often re-used year after year (USFWS, 1995). Snags, trees with exposed lateral branches, or trees with dead tops are often present in nesting territories and are critical to eagle perching, movement to and from the nest and as points of defense of their territory. Perches used for foraging are normally close to water where fish, waterfowl, seabirds, and other prey can be captured.

3.1.2 Known Occurrences in the Project Vicinity

Bald eagles have been sighted every month of the year near the reservoir, however, no nests have been confirmed in the project area. The bald eagle is year round resident within the Howard Hanson reservoir area. Although its behavior in the area is not documented, it most likely feeds on waterfowl that winter on the lake; up to two hundred ducks may be on the reservoir at any one time, providing a readily available food source for bald eagles. The forests surrounding the reservoir provide a large number of perches and potential nest trees. Food is the limiting resource, and no more than four bald eagles have been seen in the vicinity of the reservoir at any one time during the winter. Another potential limiting factor is the seasonal drawdown of the reservoir during the winter (to 1070 feet) which leaves a broad, unvegetated band between the forest and the reservoir and may discourage use by bald eagles; however, the real effect of the drawdown on eagle use has not been investigated and is unknown. The reservoir is refilled during spring and is usually raised to 1141 ft by mid-May, although the pool is raised briefly to elevations of 1143-1147 ft most years for debris clearing.

3.1.3 Effects of the Action—Phase I

3.1.3.1 Perches

Only the merchantable timber existing in the inundation zone has been proposed for logging by Tacoma prior to inundation. In addition, if logging were to occur, potential perch trees would be marked so that they would not be cut. Thus, a relatively small number of living perch trees will be removed from the existing habitat. Although the time frame for the reservoir operation would remain nearly the same, the position of perches and forest, and the configuration of the reservoir shoreline would be changed; a rough estimate, based on use of a 1 in =800 ft topographic map, is that the forest would be as much as 800 feet further removed from the low pool than under existing winter conditions. In areas of steep banks, the shoreline may be as little as 30-50 feet further removed. Artificial perch poles will be erected in specific locations within the inundation zone to compensate for the loss of existing key perches. According to the USFWS (1993), artificial perches have been used by many raptor species and are important to wintering bald eagles in situations where natural perches are lacking.

3.1.3.2 Food Supply

A number of factors could affect waterfowl numbers on Howard Hanson reservoir. First of all, there are few (resident) fish larger than 6 inches in the reservoir, although there are anadromous salmonids in the reservoir that are annually outplanted in the upper watershed that have reached lengths of 10 inches (Ging, 1998). Bald eagles typically do not eat fish less than 6 inches in length, as it is not worth the energy expended to catch them. Outplanting of juvenile salmon and steelhead above the reservoir may not continue without the AWS project, and if this occurs, fish resources in the reservoir (for bald eagles) would decline. Also, removal of trees would potentially result in less protection of the reservoir from wind, and may make the reservoir less attractive to waterfowl due to rougher water. On the other hand, for the first few years of inundation to 1167 ft, the reservoir will be more productive with the introduction of nutrients from the newly inundated strip of forest land between 1147 ft and 1167 ft elevations; should this occur, waterfowl may be enticed to stay because of the enhanced food supply--it is impossible to predict whether wind or food supply would have the greater effect on waterfowl numbers, or whether these effects would in fact occur. Experience with other reservoirs indicates that the nutrients first increase, then are depleted after a few years and the reservoirs become less productive *(Appendix F, Part One, Section 2)*. For this analysis, we would expect a fairly similar scenario to occur in Howard Hanson Reservoir: resident fish populations (cutthroat and rainbow trout, mountain whitefish) as well as those of wintering waterfowl would initially go up with the increase in nutrients, then fall again as nutrients decline over a period of years. Anadromous fish populations should diverge from the above pattern given the new fish passage facility; as natural production improves the number of juvenile salmonids should increase, while adult numbers (and carcasses) should increase dramatically. This increase in juvenile salmonid number and release of ocean-derived nutrients from carcasses could also result in increased resident fish number and size. Lastly, we would not expect the number of either resident fish or waterfowl to drop below current wintering populations, since the reservoir will maintain its current winter operation.

Food supply for bald eagles is expected to significantly increase in the upper watershed not only as a result of restoration efforts, but also as a result of increased nutrients present in the reservoir following inundation. Currently, no anadromous adult salmon exist in the upper watershed, though one to three million juveniles are outplanted in an effort to restore runs to the Green River. One objective of the AWS project and TPU P5 mitigation fish passage improvements would be to boost the natural spawning adult salmon and steelhead population to up to 10,000 individuals within 20 years (estimated total escapement used for planning purposes; *Appendix F, Part One, Section 2*). This increase in fish number will bring about a large increase in available nutrients, carcasses, and fish greater than 6 inches in size. In addition, habitat improvement efforts within the reservoir (including establishment of sedge meadows in the currently barren "bathtub ring" exposed during drawdowns) is expected to increase the population of nesting waterfowl, which currently is quite small (fewer than 10 nesting pairs). Thus, food supply for bald eagles in the upper watershed would be heightened.

Downstream, the situation is less predictable. In general, survival of anadromous salmonids streams and the mainstem river is influenced by many factors, including winter flooding and scour of incubating eggs, flow levels during juvenile emigration in the spring, minimum baseflows during summer and fall, maximum and minimum water temperatures, dissolved oxygen supply, quality of instream and riparian habitats, suspended sediment levels, and predation. Once they leave their natal streams, survival of juvenile salmon and steelhead is dependent on a number of physical and biological factors including estuary habitat quantity and quality, predation by fish, mammals or marine birds, climatic change such as elevated ocean temperatures, and by harvest by commercial, sport, or tribal fisheries.

The HHD project provides primary control of mainstem flows in the Green River, which may have secondary effects on water temperature, turbidity, and predation of juvenile anadromous salmonids. The current population status of lower river anadromous stocks can be somewhat related to operation of HHD. Tradeoffs occur as a result of the reservoir operations that provide additional storage (and existing conservation storage) by filling the reservoir in late winter to early summer for release in summer and fall -- less water is provided to the Green River below HHD in during refill, which may result in reduced spawning (steelhead), hatching (steelhead and salmon), and juvenile downstream migration success. The following analysis discusses these effects on the various salmon stocks and the resulting effects on bald eagles.

Phase I of the AWS project includes implementation of all restoration features which include the downstream fish passage facility, habitat restoration projects above and below the dam, and storage of 20,000 ac ft of M&I water supply. As part of the Second Supply Project, Tacoma will implement a mitigation agreement that will include an upstream fish passage facility, a fish restoration facility which will provide up to 500,000 coho and chinook and 350,000 steelhead fingerlings, and improved instream flows during summer and fall[2].

3.1.4 Effects of the Proposed Project.

The combined mitigation and restoration features of the AWS project and the Tacoma Mitigation Agreement will reconnect the upper Green River providing additional habitat that could support an adult spawner escapement of 1) 6500 coho salmon with production of 160,000 smolts; 2) 1300 winter steelhead with production of 25,000 smolts; and 3) 2300 chinook salmon with production of 890,000 smolts (*Appendix F; Part One Section 2;* Corps of Engineers estimates used for planning purposes). Recovery potential varies by stock, but it is assumed that even without recovery additional production of all stocks will occur through long-term supplementation if necessary. As part of the Mitigation Agreement between Tacoma and the Muckleshoot Tribe a Fish Restoration Facility – a "naturalized" rearing facility for re-establishing salmon and steelhead in the upper Green River – is available for long-term supplementation that will maintain some level of increased adult fish production from natural reared juveniles planted in the Upper Green River. Current production plans include rearing of 500,000 coho and chinook salmon and 350,000 steelhead fingerlings. Either the natural spawned fish or supplemented fish will provide a net positive benefit in returning adult salmon and steelhead that can provide increased feeding opportunities from the Diversion Dam to the headwaters of the Green River.

With a larger reservoir, juvenile passage through the reservoir to the dam will likely take longer and could result in fewer fish reaching the fish passage facility: there are no comparable small to moderate sized reservoirs available to reasonably assess the effects of an enlarged reservoir on outmigrant survival (*Appendix F, Part One, Section 2*). Reservoir and dam passage mitigation was included in the selection of the fish passage facility. The fish passage facility outflow capacity was increased to the maximum

[2] As defined in the 1995 Mitigation Agreement between the Muckleshoot Tribe and TPU. Negotiations between these parties in late winter and spring 1998 may alter these number.

volume technically feasible (from 560 cfs to 1250 cfs within NMFS screening criteria), this increased outflow capacity will greatly improve surface attraction of the facility and should decrease smolt mortality. A combination of flow management and monitoring will also be used to "optimize" operation of the project so survival of smolts through the project can be maximized. Flow management strategies include: minimizing the storage of water during the peak outmigration period, mid-April to end of May; and releasing periodic artificial freshets or mimicking natural freshets. Monitoring of smolt outmigration and predator abundance/distribution will be implemented so adaptive measures can be employed to maintain or improve smolt survival.

Per discussion with agency and tribal biologists, it has been agreed that the Second Supply Water Right diversion of 100 cfs through June 30 is assumed as the without project condition. Since this is considered the without project condition, conceptually there should be no difference between without and with project conditions as the storage volumes are the same. However, for impact analysis purposes, the springtime storage of the additional 20,000 ac ft for M&I water supply has been modeled for the historic record (years 1964-1995) to assess impacts on off-channel rearing habitat and instream migration of chum, chinook, and coho salmon and steelhead smolts. The net effect is that improved reservoir fill and release conditions should result in no decrease or an actual minor increase in total side-channel habitat area and instream survival of emigrating chinook, coho, and steelhead smolts that originate from the upper and lower watershed areas (*Appendix F; Sections 5 and 7*). Chum salmon fry are the smallest emigrant in the lower watershed and the most likely species and lifestage that would be impacted by increased storage. Modeled results showed a small decrease in chum fry survival over the period of record.

Overall, for the lower watershed, the modeling results suggest impacts of spring refill should have a neutral to slight net benefit to salmon and steelhead habitat and survival of early lifestages. Outside of the neutral impact or potential improvements from spring refill, one outcome from adaptive management in Phase I is the immediate implementation of yearly storage (5 in 5 years) of the 5,000 ac ft of Section 1135 low flow augmentation water: dependent on consensus of agency, tribal, Corps and TPU staff. Per requirement of the Muckleshoot/Tacoma Mitigation Agreement, drought year storage (1 in 5 years) will continue to be used for maintaining summer and fall minimum flows (250 cfs), in non-drought years (4 in 5 years) the 5,000 ac ft is available for use at anytime and is planned to augment flows during steelhead egg incubation in June and July. This flow augmentation will probably decrease redd dewatering and increase overall steelhead egg-to-fry survival with attendant increases in adult survival.

Lastly, there are three fish habitat restoration projects planned for Phase I including 1) annual placement of 3,900 cubic yards of gravel in the Middle Green River at Flaming Geyser (dependent on sediment transport model or monitoring); 2) side-channel reconnection in the Upper Green River at Palmer that will restore up to 3.2 acres of off-channel habitat; and 3) 3.5 miles of river and stream habitat improvement in tributaries above the inundation pool (from 1,177 to 1,240 feet elevation). These three projects should provide a clear net benefit for salmon and steelhead with improved instream and off-channel habitat for areas above and below HHD.

3.1.5 Conservation Measures

Mitigation plans propose creating nearby meadows and improving adjacent forested habitats to promote shrub understory growth. The majority of bald eagle natural perch sites will be retained and in the specific areas where that is not possible, artificial perches will be erected. Food supply may shift slightly, from a current reservoir focus to an upper watershed focus, where adult salmonids will be introduced. Food supply in the reservoir may increase temporarily following each pool raise, but would be expected to decline again to near existing levels. Downstream from HHD, the food supply (spawned salmon carcasses) would likely not increase, and may slightly decrease following implementation of the AWS Project. Food supply for bald eagles over the entire area influenced by the project (both upstream and downstream) is not expected to decline, but would instead increase as restoration efforts are taken to increase the number of adult salmon in the upper watershed (to 10,000 individuals). As a result of the proposed mitigation and restoration plans, and retention of natural perch sites, we anticipate that the bald eagle population within the sphere of influence of HHD will not be adversely affected.

3.1.6 Determination of Effect—Phase I

A determination of not likely to adversely affect is made. Mitigation measures (as described in the previous paragraphs) are expected to offset any potential adverse effects.

3.1.7 Effects of the Action—Phase II

3.1.7.1 Perches

Phase II would inundate about one half the acreage that Phase I would inundate, but would nevertheless result in the loss of additional perch trees, and widen the distance between the winter pool and the wooded shoreline. As with Phase I, perch trees in the inundation zone would be retained, and artificial perches would be erected if the number of existing perches was not adequate.

3.1.7.2 Food Supply

Although anadromous salmon would be re-established in the upper watershed in Phase I, implementation of Phase II introduces a degree of uncertainty as to the long-term viability of salmon runs in the Green River Watershed. The additional pool raise means less water enters the Green River in the spring and early summer, potentially reducing juvenile outmigrant survival, de-watering side channels and steelhead redds. This potential adverse impact has been incorporated into restoration projects, reservoir operations, and conceptual Phase II mitigation projects. Restoration features accomplished in Phase I (side channel reconnection, gravel nourishment, reconnection of the Upper Green River with fish passage, and 5,000 ac ft flow augmentation), reservoir operations tied to results of adaptive management monitoring (maximum refill rates, mimic natural hydrology, use of freshets), side channel mitigation projects designed to mitigate for modeled Phase II impacts by improving existing habitat and creating new channels (Section 8, Fish Appendix, 4-projects to mitigate for 8.4 acres), and 9,600 ac ft of summer/fall flow augmentation water will offset Phase II effects, and salmon populations are expected to remain as they were following implementation of Phase I.

With a larger reservoir, juvenile passage through the reservoir will likely take longer and could result in fewer fish reaching the passage facility. Wetlands created in Phase I will be inundated, and less area would be available for replacement of those wetlands—possibly resulting in smaller numbers of waterfowl nesting in the reservoir. These factors result in a likelihood of reduced food supply in the reservoir for bald eagles, though the reduction is expected to be negligible.

3.1.8 Conservation Measures

Conservation measures around the reservoir for Phase II would be similar in type to those implemented during Phase I, including additional sedge meadow creation, forest manipulations, snag retention and creation, and watershed stream habitat improvements. Conservation measures in the lower river would include: improvements in side channel habitat (habitat quality improvements, restoration of relic side channels), continued additions of gravel and large woody debris, spring-reservoir releases adaptively managed to protect important salmonid life-stages (based on monitoring results), and storage and release of 9,600 ac ft for optimal rearing and spawning flows in the summer and early fall.

3.1.9 Determination of Effect—Phase II

Implementation of Phase II of the HHD Additional Water Supply project is not likely to adversely affect bald eagles.

3.2. Chinook Salmon

Table 1 provides an overview of baseline conditions and effects of the proposed project on aquatic habitat indicators using the NMFS checklist for relevant indicators. Additional discussion of project effects on anadromous fish is contained in the Bald Eagle sections above.

3.2.1 Habitat Requirements/Population Status

On March 10, 1998, Puget Sound/Strait of Georgia chinook salmon stocks were proposed as a threatened species for listing under the Endangered Species Act. Summer/fall chinook of the Duwamish/Green River basin are distinguished from other Puget Sound chinook stocks by geographic isolation. The lower and middle Green River basin chinook run is mixed with Soos Creek Hatchery stocks, but the upper Green River portion of the run may be native. Coded-wire tag recoveries indicate that some hatchery strays are spawning naturally in the river (SASSI 1993). The Muckleshoot Indian Tribe is preparing to conduct genetic stock identification of the run in 1998.

Adult returns to the Green River and its tributaries have averaged 7,600 from 1987 to 1992 with an increasing trend (SASSI 1993). The runs have met escapement goals (5800 fish) in the recent past but harvest has been severely curtailed due to lower than expected smolt-to-adult survival rates. Stock status is rated healthy. Adult chinook spawn in the Green River from August through November, with peak spawning in September and October; spawning generally occurs in the mainstem from RM 28 to the Diversion Dam and in the largest tributaries. The fry emerge from January through March and rear in side channels and pools of the mainstem for days to months before migrating down to the Duwamish estuary and out to Puget Sound: peak emigration occurs from March to June. Since 1983, hatchery fingerlings have been planted above HHD.

3.2.2 Known Occurrences in the Project Vicinity

Upper Watershed

Historically, an unknown number of chinook salmon spawned in the watershed above the Tacoma Diversion Dam: an estimated 100-400 adult chinook were captured at the Diversion Dam after its completion from 1911-1913 (Grette and Salo 1986). Historical information on the Headwaters anadromous fish assemblage and the potential number of returning adults comes from trapping of adults (from hatchery egg take) at the Tacoma Diversion Dam in the early part of the century. The authors researched Washington Department of Game records and concluded that harvest and seasonal blockages below the trap could have resulted in underestimates of total chinook returns.

No spawner escapement goal has been established for the Upper Watershed by WDFW or the Muckleshoot Tribe, however, for planning purposes the Corps has estimated a potential escapement of 2300 adults. Since 1982, juvenile chinook salmon have been outplanted throughout the upper Green River from lower Green River hatchery brood stock. Fry-to smolt survival rates for these planted fish have been lower than other watersheds (Dilley and Wunderlich 1993). These lower fry-to-smolt survival rates are probably a result of high stocking rates and low survival rates of smolts migrating through HHD and Reservoir.

As part of the without-project condition, it is assumed that the Fish Restoration Facility (FRF) is in place and that the upstream trucking and release of adult chinook has begun (see Paragraph1.6.3 in the DFR/EIS). Chinook salmon juveniles rear in the reservoir and larger tributaries above the reservoir and migrate through the reservoir and dam. It is presumed that adult chinook salmon will be released in or near the reservoir and that spawning could occur in the inundation area or more likely in the mainstem and larger tributaries above this zone.

Restoration of chinook salmon to the upper Green River is dependent on project features and operations and on a number exogenous factors, including – climactic conditions, habitat quantity and quality above the project, successful operation of the FRF and upstream adult transport, lower river habitat quantity and quality, and ultimately adequate numbers of naturally spawning adults which are determined by ocean rearing conditions and fish harvest levels. Project features that can affect chinook salmon, primarily juveniles, include the operation of the fish passage facility, the size (Phase I or II pool) and rate of refill of the reservoir, the presence and abundance of terrestrial, avian or aquatic predators, and the frequency, timing, and size of freshet releases (natural or artificial), and low flow augmentation.

Lower Watershed

Historically, chinook salmon were found in the lower and middle Green River in the ten's of thousands: 55,000 were counted during spawner surveys in the late 1930s and early 1940s (Fuerstenberg et al. 1996). There is limited documentation for their presence and abundance in the upper Green River (see above).

The WDFW completed a stock status report in 1993 and concluded that at that time chinook salmon in the Green River were healthy; determination under the Endangered Species Act may be different. A Genetic Stock Inventory (GSI) sample of various parts of the river was conducted in the fall of 1997, this sample will be analyzed to determine what parts of the Green River population may still contain segments of wild Green River chinook salmon. This analysis could be important in establishing the final assessment of the Green River stock as wild, wild and hatchery, or hatchery, which could affect their protection and recovery if Puget Sound chinook salmon are listed as a threatened species. Currently, natural spawner escapement to the lower river is 5800 adults. Most of the natural spawning occurs in the mainstem river between RM 28 up to RM 60 at the Tacoma Diversion Dam. Rearing of Lower Watershed spawned juveniles occurs from RM 60 all the way to the mouth of the river. Dam and reservoir operations that affect flow releases and sediment transport also affect life stages of chinook from adult upstream migration, to spawning and egg incubation, fry emergence, juvenile rearing and, lastly, to juvenile (smolt) migration to the ocean.

3.2.3 Effects of the Action

Upper Watershed

Under the phased development juvenile fish planting would continue in the Upper Watershed until the escapement goal for naturally spawning adult chinook salmon is reached: trucking of adult salmon around the two dams would continue. After the escapement goal is met, chinook production in the Upper Watershed would be self-sustaining with sufficient numbers of juvenile salmon surviving passage through the dam and reservoir and returning as adults to perpetuate themselves for the life of the project. HHD would continue to be adaptively managed based on monitoring and evaluation results.

The pool raise will reduce the amount of natural spawning and rearing habitat in the watershed with a loss of 64,200 smolts in Phase I and 32,100 smolts in Phase II, respectively. The riparian and stream habitat lost to inundation will be fully mitigated (see Section 4 of the DFR/EIS) and these features, along with enlarged reservoir surface area could off-set these losses. Fish passage would be the restoration facility, alternative 9A8 described in Section 4 of the DRF/EIS capable of passing the median daily flow for the majority of the outmigration season; mid-April through October. With this facility, and the enlarged reservoir, estimated smolt survival through the reservoir and dam should approach 65%: baseline conditions presume chinook survival is less than 25%. This survival rate is considered conservative, given that the Corps has little to no information on juvenile chinook survival through impoundments in smaller river basins.

Chinook smolts may survive at a much higher rate especially given additional measures that will be implemented to improve smolt survival such as 1) leave all trees along the new reservoir shoreline; 2) use of woody debris in streams above, within, and below the reservoir; 3) mimicry of natural flow fluctuations with natural or artificial freshets; and 4) selective removal of predatory fish if monitoring suggests this is necessary. The estimated survival rate (65%) could enable restoration of self-sustaining runs, but there is greater uncertainty with this species relative to coho and steelhead. Achievement of self-sustaining runs will be dependent on continuing refinement of fish passage facility and reservoir operations, implementation of the habitat improvement projects, and possibly on continued curtailment of chinook harvest to a lower rate for wild stocks.

Lower Watershed

Chinook salmon spawn and rear in the mainstem, some side-channels and larger tributaries from the Diversion Dam to RM 28. Under Phase I there should be a neutral impact or slight improvement in the population status of this run. Water temperatures during late summer and fall will be improved, woody debris would be added at Kanaskat and the side channel restoration at RM 58-59 will provide a large, protected spawning and rearing area. Also, if adaptive management is successful, gravel movement out of the reservoir could be reinitiated and would provide suitable sized materials for spawning habitat in the Kanaskat reach.

Implementation of gravel nourishment in the Middle Green River should retard bed armoring and replace suitable sized spawning gravels in this gravel-starved reach providing valuable spawning habitat for this mainstem spawning stock. Spring refill may reduce this benefit from decreasing peak flows during the seaward migration of juvenile chinook. Under Phase II, there would be a slight reduction in the population status due to the additional storage of water and further reduction in peak flows affecting spring migration of juvenile chinook and by dewatering of off-channel habitat. Low flow augmentation during late summer and early fall could offset this impact.

3.2.4 Conservation and Mitigation Measures

In Phase I, all habitat restoration features will be implemented as will the fish passage facility. Mitigation includes modifying reservoir operations to mimic natural hydrology patterns and to avoid or minimize impacts to Lower Watershed fish. Operational modifications will include – 1) minimum lower river baseflows during spring refill; 2) maximum refill rates; 3) passing natural and creating artificial freshets; and 4) use of the "dampening dam"[3]. A variety of habitat improvements will be used to mitigate for the loss of riparian and stream habitat inundated by the Phase I pool including: 1) leave of all trees around the reservoir; 2) planting of inundation tolerant plants; 3) use of LWD and boulders to maintain stream habitat within the reservoir; 4) LWD placement in larger tributaries above the reservoir; 5) creation of riparian reserves; 6) forest management to accelerate late successional forest characteristics in riparian areas; and 7) replacement of culverts around the reservoir and in 3 additional stream above the reservoir. A 15-year monitoring and evaluation program will be used in an adaptive management program to refine reservoir operations and to maximize efficiency of the fish passage and habitat improvement projects. Lastly, if monitoring suggests the need, selective removal of avian or piscine predators will be initiated based on agency and tribal recommendation.

In Phase II, adaptive management will continue to be used to modify reservoir operations to avoid and minimize impacts to smolts emigrating through the reservoir and to eggs, fry, and smolts using habitat below the project. Low-flow augmentation can be used to maintain baseflow in summer and fall. Like Phase I, a mixture of habitat improvements will be implemented to mitigate for the inundation of riparian and stream habitat. Adaptive management monitoring and evaluation will continue through Phase II.

3.2.5 Determination of Effect

Phase I is not likely to jeopardize the continued existence of the Green River chinook salmon population.

At the earliest, Phase II is scheduled to commence 5 years after Phase I, and is not likely to jeopardize the continued existence of the Green River chinook salmon population. However, it is likely there will be a negative effect.

3.3. Puget Sound Coho.

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[3]The "Dampening Dam" is a concept of adaptively storing water during spring refill above the conservation pool and M&I storage rule curves for use in protecting instream resources. The dampening dam was experimentally used this spring: water was stored earlier than normal for a planned release of an artificial freshet of approximately 5,000 ac ft on April 18.

Table 1 provides an overview of baseline conditions and effects of the proposed project on aquatic habitat indicators using the NMFS checklist for relevant indicators. Additional discussion of project effects on anadromous fish is contained in the Bald Eagle sections above.

Puget Sound/Strait of Georgia coho salmon stocks are a candidate species for listing under the Endangered Species Act. A preliminary stock status review considered that "listing is not presently warranted" (NMFS preliminary status review as cited in WDFW 1997).

3.3.1 Habitat Requirements/Population Status/Known Occurrence in Project Area

The lower and middle Green River basin coho run is mixed with Soos Creek hatchery stocks, but the upper Green River portion of the run may be native. The runs of wild, natural spawned fish have not met escapement goals (8,700 fish) in the recent past (SASSI, 1993). Adult coho spawn in the Green River from September through January; spawning generally occurs in tributaries and side channels. The fry emerge from March through June and rear in side channels and pools of the mainstem and its tributaries for one year before migrating down to the Duwamish estuary and out to Puget Sound. Since 1983, hatchery fingerlings have been planted above HHD. Fry-to smolt survival rates for these planted fish have been lower than other watersheds (Dilley and Wunderlich 1993). These lower fry-to-smolt survival rates are probably a result of high stocking rates and low survival rates of smolts (25% or less) migrating through HHD and Reservoir (*Appendix F, Section 2*). Historically, an estimated 9-27,000 coho salmon spawned in the watershed above the Tacoma Diversion Dam (Grette and Salo 1986).

No spawner escapement goal has been established for the Upper Watershed by WDFW or the Muckleshoot Tribe, however, for planning purposes the Corps has estimated a potential escapement of 6500 adults.

3.3.2 Effects of the Action

Upper Watershed

Under the phased development with environmental restoration juvenile fish planting would continue in the Upper Watershed until the escapement goal for naturally spawning adult coho salmon is reached. After the escapement goal is met, coho production in the Upper Watershed would be self-sustaining with sufficient numbers of juvenile salmon surviving passage through the dam and reservoir and returning as adults to perpetuate themselves for the life of the project. HHD would continue to be adaptively managed based on monitoring and evaluation results.

The pool raise will reduce the amount of natural spawning and rearing habitat in the watershed with a loss of 6500 smolts in Phase I and 3250 smolts in Phase II, respectively: the USFWS estimated the loss of smolt production by species but provided no overall estimate for adult habitat (Wunderlich and Toal 1992). The riparian and stream habitat inundated will be fully mitigated (See *DFR/EIS, Section 4*) and these features, along with enlarged reservoir surface area could off-set these losses. Fish passage would be the restoration facility, alternative 9A8 described in *Section 4* of the *DFR/EIS*, capable of passing the median daily flow for the majority of the outmigration season; mid-April through October. With this facility, and the enlarged reservoir (which could reduce survival), estimated smolt survival through the reservoir and dam should approach 85-90%. Such a high survival rate will likely enable restoration of self-sustaining runs and could eliminate the need for permanent supplementation of the Upper Watershed run with hatchery fish. However, achieving a self-sustaining run will be dependent on continuing refinement of fish passage facility and reservoir operations, implementation of the habitat improvement projects, and probably on continued curtailment of coho harvest to a lower rate for wild stocks.

Lower Watershed

Coho salmon spawn and rear in the mainstem, side-channels, and tributary streams below the Tacoma Diversion Dam. Under Phase I there should be a neutral impact to slight improvement in the population status of this run. Water temperatures during late summer and fall will be improved, woody debris would be added at Kanaskat, and the side channel restoration at RM 58-59 will provide a large, protected spawning and rearing area. Also, if adaptive management is successful, gravel movement out of the reservoir could be reinitiated and would provide suitable sized materials for spawning habitat in the Kanaskat reach.

Implementation of gravel nourishment in the Middle Green River should retard and replace suitable sized spawning gravels in this gravel starved reach. Spring refill may reduce this benefit from decreasing peak flows during the seaward migration of juvenile coho. Reservoir operations will mimic natural hydrology and attempt to avoid or minimize impacts to Lower Watershed fish. Operational features will include – 1) minimum baseflows during spring refill; 2) maximum refill rates; 3) passing natural and creating artificial freshets. Under Phase II, there would be a slight reduction in the population status due to the additional storage of water and further reduction in peak flows affecting spring migration of juvenile coho and by dewatering of off-channel habitat. Low flow augmentation during summer through early fall could offset this impact. Four side-channel projects are proposed to mitigate for dewatering of 8.4 acres of side-channel habitat.

3.3.3 Conservation and Mitigation Measures

In Phase I, all habitat restoration features will be implemented as will the fish passage facility. Mitigation includes modifying reservoir operations to mimic natural hydrology patterns and to avoid or minimize impacts to Lower Watershed fish. Operational modifications will include – 1) minimum lower river baseflows during spring refill; 2) maximum refill rates; 3) passing natural and creating artificial freshets; and 4) use of the "dampening dam"[4]. A variety of habitat improvements will be used to mitigate for the loss of riparian and stream habitat inundated by the Phase I pool including: 1) leave of all trees around the reservoir; 2) planting of inundation tolerant plants; 3) use of LWD and boulders to maintain stream habitat within the reservoir; 4) LWD placement in larger tributaries above the reservoir; 5) creation of riparian reserves; 6) forest management to accelerate late successional forest characteristics in riparian areas; and 7) replacement of culverts around the reservoir and in 3 additional stream above the reservoir. A 15-year monitoring and evaluation program will be used in an adaptive management program to refine reservoir operations and to maximize efficiency of the fish passage and habitat improvement projects. Lastly, if monitoring suggests the need, selective removal of avian or piscine predators will be initiated based on agency and tribal recommendation.

In Phase II, adaptive management will continue to be used to modify reservoir operations to avoid and minimize impacts to smolts emigrating through the reservoir and to eggs, fry, and smolts using habitat below the project. Low-flow augmentation can be used to maintain baseflow in summer and fall. Like Phase I, a mixture of habitat improvements will be implemented to mitigate for the inundation of riparian and stream habitat. Adaptive management monitoring and evaluation will continue through Phase II.

3.3.4 Determination of Effect

All restoration projects are implemented in Phase I. Overall, Phase I is likely to beneficially affect the Green River coho salmon population.

Phase II is likely to adversely affect Green River coho salmon. Impacts include 1) inundation of rearing and spawning habitat in reservoir tributaries (1167-1177 ft), 2) potential reductions in smolt survival through the enlarged reservoir (relative to Phase I); 3) by possible dewatering of coho salmon redds in side-channel and mainstem margins; and 4) decreased survival of emigrating smolts in the Lower Watershed.

3.4 Sea-Run Cutthroat

Table 1 provides an overview of baseline conditions and effects of the proposed project on aquatic habitat indicators using the NMFS checklist for relevant indicators. Additional discussion of project effects on anadromous fish is contained in the Bald Eagle sections above.

Sea-run cutthroat trout is a candidate species for listing under the Endangered Species Act.

3.4.1 Habitat Requirements/Population Status

Sea-run cutthroat spawn in small tributaries of large or small streams with a drainage area of less than 13 km (Pauley, 1989). Cutthroat (sea-run, fluvial, and resident populations) are known to spawn in numerous river systems throughout western Washington (Pauley, 1989). The population status of sea-run cutthroat is unknown, but believed to be declining. Sea-run cutthroat are often repeat spawners, which means they migrate downstream and back to sea as adults. In general, cutthroat trout are considered headwater specialists with a freshwater distribution and habitat use associated with higher elevation, lower order streams. Stream surveys by the US Forest Service and Plum Creek have shown that cutthroat trout are found in most accessible streams in the upper Green River. There are at least two adfluvial, natural lake-dwelling and migratory, populations in the Green River – one is in Lake Sawyer and the second is Eagle Lake.

3.4.2 Known Occurrences in the Project Vicinity

Little is known about the occurrence of sea-run cutthroat in Middle and Upper Green River sub-basins. Resident and fluvial migratory fish are present throughout the Green River basin. It is unclear if these remaining stocks retain a genetic component for anadromony. Wunderlich and Toal (1992) speculated that adfluvial cutthroat trout use HH Reservoir during the summer conservation pool, spawning in nearby tributaries during spring refill. The authors observed large rainbow and cutthroat trout at tributary confluences. Surveys of the upper reservoir by the WDFW have shown that juvenile cutthroat rear along the shoreline but trout greater than 8 inches in size were not caught (T. Cropp, undated, WDFW). Surveys in the lower 0.5 miles of the reservoir have shown no large trout and limited numbers of juvenile trout (Dilley 1993). The effects of seasonal drawdown of the conservation pool (exposing the heavily sedimented and degraded inundated stream reaches) on habitat use and movement of juvenile and adult cutthroat have not been documented.

There has been little success in maintaining viable runs of sea-run cutthroat above impoundments in west-coast river basins. Even in Lake Washington, where runs of steelhead and salmon have been maintained for 80 years, it appears the sea-run component is virtually extinct. WDFW observers at the Ballard Locks have noted few returning adults (B. Winters, pers. comm., WDFW). Restoration efforts on the Cowlitz River to recover sea-run cutthroat above a series of impoundments have not been successful to date.

3.4.3 Effects of the Action

Upper Watershed

If migratory or resident cutthroat trout in the project area still retain anadromy as a genetic trait, both adult and juvenile sea-run cutthroat could be adversely impacted by the increase in pool size (inundating spawning habitat within 1147-1167 ft pool for Phase I) and earlier refill of the project. Conversely, with the habitat restoration proposed above the project, and if restoration of coho and chinook salmon is successful, cutthroat trout populations are expected to improve. However, if resident or fluvial cutthroat (along with rainbow trout) were to become significant predators of emigrating juvenile salmon and steelhead, it would be prudent to consider selective removal of larger trout if the restoration of salmon and steelhead is a priority. The Upper Watershed is closed to fishing so resident trout populations above the Diversion Dam are unfished.

Lower Watershed

Cutthroat populations below the project will benefit from the improved outflow temperature releases from the dam to approximately RM 57. Phase I refill operations should improve conditions for smolt emigration by mimicking the natural hydrology. Truck and haul of large wood from the reservoir to release below the dam will improve LWD in the Palmer area. In the Middle Green River gravel nourishment will provide improved spawning conditions from RM 41-47. If Phase II occurs, refill would have negative impacts on smolt emigration but flow augmentation should improve low-flow conditions for juvenile rearing and late spring/early summer spawning: refill constraints would include minimum baseflows, maximum refill rates, and use of artificial freshets to maintain instream migration conditions.

3.4.4 Conservation Measures

No conservation measures were specifically proposed for this species since the project goal is restoration of anadromous fish stocks above the project and avoiding or minimizing impacts to anadromous fish below the project.

3.4.5 Determination of Effect

Given the uncertainty of sea-run cutthroat being in the project area, and with the project emphasis on anadromous fish recovery, the project is not likely to adversely affect sea-run cutthroat trout.

3.5 Chum Salmon

Table 1 provides an overview of baseline conditions and effects of the proposed project on aquatic habitat indicators using the NMFS checklist for relevant indicators. Additional discussion of project effects on anadromous fish is contained in the Bald Eagle sections above.

3.5.1 Habitat Requirements/Population Status

Puget Sound chum salmon (*O. keta*) are not a candidate species for listing under the Endangered Species Act, as such, this discussion is more general to the project impacts for this species. Two chum stocks are recognized in the Green River system (SASSI 1993). The Crisp (Keta) Creek fall chum stock originated from releases of Quilcene and Hood Canal stocks from the Keta Creek hatchery in the early 1980's. This stock is considered healthy. The Duwamish/Green stock has been considered a remnant native stock, but their status is unknown. A genetic stock inventory conducted by the Muckleshoot Indian Tribe found that the natural spawners were composed of Hood Canal and South Puget Sound hatchery stocks with no evidence of a native stock component (M. Mahovolitch, pers. comm.). The natural spawning run is considered to be in a rebuilding state and an adult escapement goal has not been established.

3.5.2 Known Occurrences in the Project Vicinity

Adult chum salmon migrate up the Green River from early November to the first week of December. Spawning occurs from mid November through December, in the mainstem Green River between Burns Creek and Crisp Creek (SASSI 1993). Recent surveys have found spawners up to the RM 45 in side channels of Flaming Geyser State Park (B. Fuerstenberg, King County, pers. comm.) . Muckleshoot Tribal biologists surveyed the Green River during 1996 and reported significant chum spawning in side channels in the middle and lower Green River reaches. The fry emerge from mid-February to July and rear from days to weeks in side-channel and mainstem backwater habitats. The peak downstream migration of chum salmon fry occurs from late March through May.

3.5.3 Effects of the Action and Conservation/Mitigation Measures

Lower Watershed

Under Phase I there should be a slight improvement in the population status of this run. Implementation of gravel nourishment in the Middle Green River should retard and replace suitable sized spawning gravels in this gravel starved reach. If adaptive management is successful, gravel movement out of the reservoir could be reinitiated and would provide suitable sized materials for spawning habitat in the Kanaskat reach: however, it is uncertain whether chum salmon spawn as far as Kanaskat. Spring refill may reduce the benefit from gravel nourishment by decreasing peak flows during the seaward migration of juvenile chum. Reservoir operations will mimic natural hydrology and attempt to avoid or minimize impacts to Lower Watershed fish. Operational features will include – 1) minimum baseflows during spring refill; 2) maximum refill rates; 3) passing natural and creating artificial freshets.

Under Phase II, there would be a slight reduction in the population status due to the additional storage of water and further reduction in peak flows further affecting spring migration of juvenile chum salmon and by dewatering of off-channel habitat. Low flow augmentation during fall could offset this impact. Four side-channel projects are proposed to mitigate for dewatering of 8.4 acres of side-channel habitat.

3.5.4 Determination of Effect

Phase I is not likely to adversely effect the Green River chum salmon population.

Phase II storage may adversely effect the chum salmon stock. Low flow augmentation and side-channel habitat improvements could off-set this loss.

3.6 Winter Steelhead

Table 1 provides an overview of baseline conditions and effects of the proposed project on aquatic habitat indicators using the NMFS checklist for relevant indicators. Additional discussion of project effects on anadromous fish is contained in the Bald Eagle sections above.

3.6.1 Habitat Requirements/Population Status

Puget Sound steelhead (*O. mykiss*) are not a candidate species for listing under the ESA, as such, this discussion is more general to the project impacts. A stock status review considered that Puget Sound steelhead are not presently warranted for listing. Steelhead are differentiated into two types: winter steelhead and summer steelhead. Winter and summer steelhead are differentiated by timing of adult return but share common juvenile behavior patterns.

3.6.2 Known Occurrences in the Project Vicinity

Winter steelhead adults return to the Green River from November through early June and summer adults from April through November (Caldwell 1994). Winter steelhead are native to the Green River while summer steelhead are non-native to the Green River (Skamania River) and are primarily maintained by hatchery plants. Winter steelhead spawn from January through June with the peak in spawning in April and May. Spawner escapements for wild winter steelhead has been close to or exceeds goals (2100 fish) in most years, and the status of the stock is healthy. A limited number of summer steelhead spawn in the Green River, usually from mid-January to early April. Many of these fish spawn below the Palmer rearing ponds at RM 56. A significant difference between steelhead and Pacific salmon life history is that not all steelhead die after spawning. Steelhead are capable of repeat spawning. Repeat spawning in Washington ranges from of 4.4 to 14.0 percent of total spawning runs (Wydoski and Whitney 1979).

Both winter and summer juvenile steelhead rear in freshwater for one to two years, mostly two, before migrating to the ocean. Juvenile downstream migration occurs from April through July, with peak migration in mid-April (*Appendix F, Section 5*). Since 1982, hatchery fingerlings have been planted above HHD. Fry-to smolt survival rates for these planted fish have not been estimated but probably follow the trend for coho and chinook salmon, which have been lower than other watersheds (Dilley and Wunderlich 1993). The lower fry-to-smolt survival rates are probably a result of high stocking rates and low survival rates (25%<) of smolts migrating through HHD and Reservoir. Historically, an estimated 500-5200 adult steelhead were captured at the Diversion Dam after its completion from 1911-1913 (Grette and Salo 1986). Since 1991, a temporary fish trap has been operated at the Diversion Dam, returns of steelhead have ranged from

30 to 150 adults. These fish are either released above the dam for natural spawning, or a select few are used to rear fry for outplanting in the upper watershed to attempt to maintain the small run. No spawner escapement goal has been established for the Upper Watershed by WDFW or the Muckleshoot Tribe, however, for planning purposes the Corps has estimated a potential escapement of 1300 adults.

3.6.3 Effects of the Action and Conservation/Mitigation Measures

Upper Watershed

Under phased development juvenile fish planting from the FRF or similar facility would continue in the Upper Watershed until the escapement goal for naturally spawning steelhead is reached. After the escapement goal is met, steelhead production in the Upper Watershed would be self-sustaining with sufficient numbers of juvenile steelhead surviving passage through the dam and reservoir and returning as adults to perpetuate themselves for the life of the project. HHD would continue to be adaptively managed based on monitoring and evaluation results.

The pool raise will reduce the amount of natural spawning and rearing habitat in the watershed with a loss of 990 steelhead smolts in Phase I and 500 smolts in Phase II, respectively. The riparian and stream habitat inundated will be fully mitigated (see *DFR/EIS, Section 4*) and these features, along with enlarged reservoir surface area could off-set these losses. Fish passage would be the restoration facility, alternative 9A8 described in Section 4 of the DFR/EIS, capable of passing the median daily flow for the majority of the outmigration season; mid-April through October. With this facility, and the enlarged reservoir, estimated smolt survival through the reservoir and dam should approach 90%. Such a high survival rate will likely enable restoration of self-sustaining runs and will eliminate the need for permanent supplementation of the Upper Watershed run with hatchery fish. However, achieving a self-sustaining run will be dependent on continuing refinement of fish passage facility and reservoir operations, implementation of the habitat improvement projects, and possibly on short-term curtailment of steelhead harvest to a lower rate for wild stocks.

A 15-year monitoring and evaluation program will be used in an adaptive management program to refine reservoir operations and to maximize efficiency of the fish passage and habitat improvement projects.

Lower Watershed

Steelhead spawn and rear in the mainstem, a few side-channels, and larger tributary streams below the Tacoma Diversion Dam. Under Phase I there should be a neutral impact or slight improvement in the population status of this run. Water temperatures during late summer and fall will be improved by dam releases and the side channel restoration at RM 58-59 will provide a large, protected spawning and rearing area. Also, if adaptive management is successful, gravel movement out of the reservoir could be reinitiated and would provide suitable sized materials for spawning habitat in the Kanaskat reach.

Implementation of gravel nourishment in the Middle Green River should retard and replace suitable sized spawning gravels in this gravel starved reach. Spring refill may reduce this benefit from flows during the peak spawning period of adult steelhead. Under Phase II, there would be a slight reduction in the population status due to the additional storage of water and further reduction in peak flows during spring emigration of juvenile steelhead and by possible dewatering of steelhead redds. Low-flow augmentation during late spring to mid summer could offset this impact.

3.6.4 Determination of Effect

All restoration projects are implemented in Phase I. Phase I is likely to beneficially effect the Green River steelhead population.

Phase II is likely to adversely effect the Green River steelhead population. Impacts include 1) loss of spawning and rearing habitat in tributaries inundated by the larger reservoir (1167-1177 ft); and 2) by possible dewatering of steelhead redds in the Lower Watershed.

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Table 1. NMFS checklist for documenting environmental baseline and effects of proposed actions on relevant indicators. Three tables are prepared for three distinct areas of the Green River -- 1) Table 1.a. Lower and Middle Green River, RM 0-57; 2) Table 1.b. Upper Green River (Palmer Reach) from HHD to beginning of Green River Gorge, RM 57-64.5; and Table 1.c. Upper Green River above HHD, RM 64.5-88. Unless otherwise noted, restoration actions are just that -- actual restoration projects (beyond what is necessary for mitigation) that are implemented by year 1 of Phase I.

Table 1.a. Lower and Middle Green River, RM 0-57

		Environmental Baseline			Effects of the Actions		
Pathways	Indicators	Properly Functioning	At Risk	Not Properly Functioning	Restore	Maintain	Degrade
Water Quality:							
	Temperature			Max summer temps exceed 64F almost every year in mainstem spawning areas; nearshore temperatures are 1-4 F higher in juvenile rearing areas	Dam releases unlikely to improve temps downstream of RM 57; Phase I 5,000 ac ft of flow augmentation could marginally improve temps and Phase II 9,600 ac ft could do more		
	Sediment/ Turbidity	Turbidity low to protect water diversion				Short-term impacts after pool raise from bank-calving; to maintain turbidity levels - retain flooded timber, plant inundation tolerant plants	
	Sediment Transport			Peak flows reduced and gravel and coarse sediments are stored behind HHD; loss of 700-1,000 linear ft of mainstem habitat per year (by reduction of 3,900-11,700 cu yd. of coarse sediment transport/yr.)	Gravel nourishment is planned for below Green River Gorge (RM 45) at 3,900 cu yd./year to maintain 400,000 ft2 of spawnable area; this is considered maximum nourishment amount possible so flood protection is not affected		
	Chemical Contamination		Agriculture discharges in Middle Green	Toxic sediments in Lower Green		Flow augmentation could dilute agriculture discharges but does nothing for toxics	
	Nutrient Transport/ Salmon Carcasses		Lowered numbers of wild spawning populations from historical levels[1]		Increased spawning habitat in Middle Green River from gravel nourishment	Phase II storage potentially impacts embryos and fry by reducing instream flows in late winter; avoidance and mimization dependent on monitoring and evaluation; mitigation options include refill baseflows, low-flow flow augmentation and side-channel impro	
Habitat Access: Physical Barrier--Flow-related, depth too shallow for adult upstream migration; reduction of spring freshets affecting juvenile downstream migration							
	Upstream Passage		Drought conditions have led to delay and at least one year of actual entrapment of chinook salmon in lower river pools during upstream migration through the lower river		Phase I and Phase II flow augmentation can increase base-flows and/or provide summer freshets to improve upstream migration		
	Downstream Passage		Recent reservoir refill operations have included capture of natural freshets which may reduce survival of outmigrating juveniles; no monitoring has occurred to date		Proposed reservoir operations include maximum refill rates, mimicking natural hydrology by passing natural and artificial freshets; with a Phase I 2-year pre & 5-year post-project monitoring and evaluation program of juvenile migration		

Habitat Elements:					
Substrate		No documentation of gravel availability RM 45 57, bed armoring to cobble-size and channel downcutting is apparently limiting gravel sized sediments and spawning availability in the river from RM 41-47		Gravel nourishment is planned for below Green River Gorge (RM 45) at 3,900 cu yd./year	
Large Woody Debris	Riparian zone is largely intact RM 36-57	Increasing loss or riparian zone RM 32-36 from levee constrictions	Little to no riparian zone below RM 32		Project operations will not affect lower and middle river riparian zones
Pool Frequency		Bedrock and boulder created pools RM 45-57, fewer pools RM 32-45	Little or no pools RM 11 32		Project operations are planned so as not to affect lower and middle river pool frequency
Pool Quality		Bedrock/boulder pools from RM 45-57; RM 32-45 little LWD	Below RM 32 little LWD, shallow depths, no riparian zone	Phase I and Phase II flow augmentation is expected to improve quality with increased flows	
Off-channel Habitat		Historic side-channels largely inaccessible & greatly reduced area;	Virtually no side-channel habitat below RM 32, or estuarine wetlands (98% loss)	Phase I monitoring and evaluation includes 3 years pre-project and 1-5 years post-project assessment of reservoir operations on habitat and fish use	<u>Phase II mitigation</u> includes mitigation for 6.4 acres of habitat dewatered during spring refill
Refugia			Bedrock and boulder created pools RM 45-57; little LWD; no off-channel habitat below RM 32; temperatures at risk		Phase I and Phase II flow augmentation could improve quality with increased flows; Phase II refill reduces off-channel habitat and requires mitigation
Channel Condition and Dynamics					
Width/Depth Radio		RM 45-57 may have limited areas exceeding 10	Areas below RM 30 largely >12		Project operations should not affect lower and middle river width/depth ratios
Streambank Condition			>90% stable however, reduced peak flows have reduced bank erosion but increased channel downcutting and levee construction has constrained RM 0-32		Project operations should not affect lower and middle river width streambank stability
Floodplain Connectivity			Severe reduction from dam dampening; levee confinement from RM 0-32		Phase I Project operations should not affect lower and middle river floodplain connectivity, Phase II dewaters 6.4 acres during spring refill; appropriate mitigation will be applied

Flow/Hydrology						
Peak/Base Flows		Base-flows reduced by diversion but reliability of minimums is increased from HHD and from pending MIT/Tacoma mitigation agreement	Peak flows – severe reduction from dam dampening; freshets have been reduced for refill reliability	Base-flows improved from MIT agreement and yearly 5,000 ac ft in Phase I; Phase I freshets improved with refill maximums and artificial freshets; Phase I monitoring and evaluation includes 2 years pre-project and 5 years post-project evaluation of juvenil	Peak flow reduction not affected by new project operations; in Phase II freshets in late winter could be reduced but spring freshets maintained with max. refill rates or artificial freshets	
Watershed Conditions						
Road Density and Location		Some valley bottom roads			Maintain density, provide access to off-channel area with new culvert/river diversion	
Riparian Reserves			Loss of LWD sources from above HHD	Transport of limited no. of LWD from HHD reservoir		

1. Fuerstenburg et al. (1996) compared escapements from 1930's to late 1980's and early 90's.

2. Although the new Diversion Dam has a fish ladder and truck and haul, upstream salmon and steelhead release would be limited or eliminated without improved downstream fish passage at HHD.

3. Dam survival through the new fish passage could be greater than 95% and collection efficiency could exceed 95% for migrants that have survived transport through the reservoir; reservoir survival is less certain.

Table 1.b. Upper Green River (Palmer Reach) from HHD to beginning of Green River Gorge, RM 57-64.5

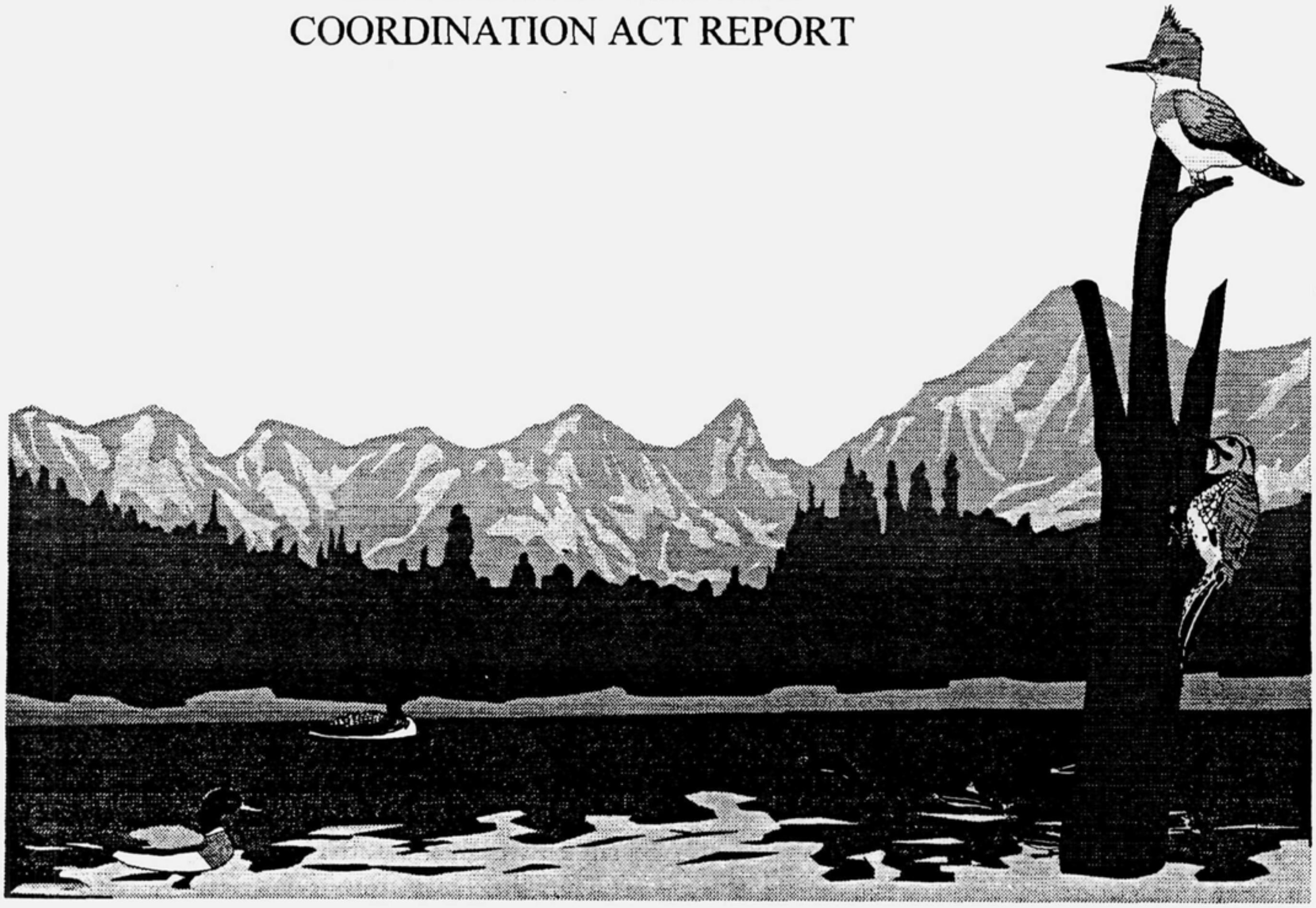
Pathways	Indicators	Environmental Baseline: Properly Functioning	Environmental Baseline: At Risk	Environmental Baseline: Not Properly Functioning	Effects of the Actions: Restore	Effects of the Actions: Maintain	Effects of the Actions: Degrade
Water Quality:	Temperature		Dam releases exceed 63 F in summer and 60 F in fall using deep-water outlets		With surface and deep-water outlets – modeled temps show reduce Summer releases below 60F & Fall releases below 58 F		
	Sediment/ Turbidity	Turbidity low to protect water diversion				Short-term impacts after pool raise from bank-calving; to maintain turbidity levels - retain flooded timber, plant inundation tolerant plants	
	Sediment Transport			Peak flows reduced and gravel and coarse sediments are stored behind HHD	A 3/4 mile long side-channel will be restored, will attempt re-initiate gravel transport		
	Chemical Contamination	Low levels				Low levels	
	Nutrient Transport/ Salmon Carcasses		Lowered numbers of wild spawning populations from historical levels[1]		Increased spawning habitat & potential carcasses – reconnection of U. Green River, side-channel restoration at RM 58-59		
Habitat Access: Physical Barriers	Upstream Passage		Temporary Tacoma Fish Ladder and Truck and Haul above HHD for steelhead; New Diversion Dam will have Fish Ladder and Truck and Haul but use is uncertain[2]		New Diversion Dam Fish Ladder and Truck and Haul above HHD implemented with the MIS/Lock downstream fish passage facility[2]		
	Downstream Passage	Current Tacoma Diversion Dam has had a poorly screened intake; New Diversion Dam has a screened, new juvenile bypass system		Coho smolt survival through HH Dam and Reservoir is 28% of below-dam-releases; chinook is probably lower	New Diversion Dam has a screened, new juvenile bypass system; HHD MIS/Lock Facility could increase HH Dam survival to >95% for coho and chinook[2] monitoring and evaluation include 15 years of post-project study of dam passage		
Habitat Elements:	Substrate		Dominant is cobble with few gravels and little new recruitment (see sediment transport)		New side-channel with gravel placement; attempt re-initiation of gravel movement		
	Large Woody Debris		Riparian zone is largely intact RM 57-64.5, no transport from above HHD, all wood is collected in reservoir and removed		Proposed+F65 collecting, truck and haul of a limited no. of logs, release between RM 59-60; add LWD to side-channel		
	Pool Frequency		Bedrock and boulder created pools, little LWD, little to no off-channel pool		Restore side-channel at RM 58-59 with pools, truck and haul LWD		

Pool Quality		Little LWD, little to no off-channel pools		Side-channel pools with LWD, truck and haul LWD	
Off-channel Habitat			Historic side-channels largely inaccessible & greatly reduced area	Restore a 3/4 mile long side-channel; <u>Phase II mitigation for 2.0 acres dewatered</u> includes parallel side-channel restoration on right bank	
Refugia		Bedrock and boulder created pools; little LWD; little to no off-channel pool; temperatures at risk		Restore 3/4 mile side-channel at RM 58-59 with pools/LWD; truck and haul LWD; reduced dam temperatures	
Channel Condition and Dynamics					
Width/Depth Radio		Limited areas may exceed 10			Unclear if LWD transport could reduce below 10
Streambank Condition	>90% stable, reduced peak flows have reduced bank erosion but increased channel downcutting				Maintain bank stability, transport LWD
Floodplain Connectivity			Severe reduction from dam dampening and road construction on left bank	Reconnect side-channel with river diversion and culverts through road berm	
Flow/Hydrology					
Peak/Base Flows		Base-flows reduced by diversion but reliability of minimums is increased from HHD	Peak flows -- severe reduction from dam dampening; freshets have been reduced for refill reliability	Base-flows improved from MIT agreement and yearly 5,000 ac ft in Phase I; freshets improved with refill maximums and artificial freshets	Peak flow reduction continues
Watershed Conditions					
Road Density and Location		Some valley bottom roads			Maintain density, provide access to off-channel area with new culvert/river diversion
Riparian Reserves			Loss of LWD sources from above HHD	Transport of limited no. of LWD from HHD reservoir	

1. Fuerstenburg et al. (1996) compared escapements from 1930's to late 1980's and early 90's.
2. Although the new Diversion Dam has a fish ladder and truck and haul, upstream salmon and steelhead release would be limited or eliminated without improved downstream fish passage at HHD.
3. Dam survival through the new fish passage could be greater than 95% and collection efficiency could exceed 95% for migrants that have survived transport through the reservoir; reservoir survival is less certain.

HOWARD HANSON
ADDITIONAL WATER STORAGE PROJECT

U.S. FISH AND WILDLIFE
COORDINATION ACT REPORT



U.S. Fish and Wildlife Service
North Pacific Coast Ecoregion
Western Washington Office
Lacey, WA

July 1998

U.S. Fish and Wildlife Service

Fish and Wildlife Coordination Act Report

HOWARD HANSON ADDITIONAL WATER STORAGE PROJECT

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INTRODUCTION

This Coordination Act Report (CAR) presents the U.S. Fish and Wildlife Service's (Service) conclusions on the benefits and adverse impacts to fish and wildlife that can be expected to occur if Howard Hanson Dam and Reservoir (HHDR) are used to store additional water and the proposed mitigation/restoration measures for fish and wildlife are provided. This report is based on the project description and the related information provided in the Corps of Engineers' (Corps) draft environmental impact statement and on the biological studies that have been conducted over the last seven years during the feasibility phase of this project. This CAR is being provided under the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended: 16 U.S.C. 661, et seq.) and fulfills Section 2(b) of this Act.

The Corps of Engineers (Corps) and the City of Tacoma (Tacoma), the federal and local sponsors, respectively, propose operational and structural modifications of Howard Hanson Dam and Reservoir to improve the dependability of Tacoma's water supply and to correct fish and wildlife problems caused by HHDR.

The Corps' Howard Hanson Dam and Reservoir (formerly called the Eagle Gorge Dam and Reservoir) was authorized by the Flood Control Act of 1950, and was completed in 1962. It was constructed without any provisions for fish passage because the Tacoma Diversion Dam, built in 1913 and located just 3.5 miles downstream, was already a total barrier to upstream fish migration. The HHDR's authorized purposes include flood control, low flow augmentation, irrigation and water supply, although the project is not currently operated for irrigation or water supply.

Tacoma, which currently obtains a major part of its water supply from the Green River, seeks to address its future water demand by utilizing up to 22,400 acre-feet of the storage capacity of HHDR when it is not needed for flood control. Water would be stored during the late winter and spring, held and then used during the summer and early fall when Tacoma's water demand is higher.

The project sponsors propose to include several project features designed to correct existing fish and wildlife problems caused by the construction of the dam and by the current operation, and to mitigate impacts that would result from increasing the size of the conservation pool. The main project element involves the construction of downstream fish passage facilities at HHDR. These improvements, along with the fish passage facilities being planned at Tacoma's diversion dam under a separate agreement, would restore anadromous fish access to more than 100 miles of their former habitat. Other project elements include adoption of an adaptive management approach to project operation, storing additional water for flow augmentation, improving habitat both downstream from HHDR and above the conservation pool, and monitoring the effects of the new project.

The Service has participated in the development of the proposed project since the mid 1980's. We have been actively involved in both the design and implementation of the fishery and terrestrial wildlife studies, as well as the selection of the proposed project elements.

PROJECT LOCATION AND SETTING

The area affected by the proposed project includes HHDR, the proposed mitigation lands, the 64.5 miles of the Green River below HHDR that would be subjected to a modified flow regime, and the 106 miles of habitat upstream from HHDR that would again be accessible to anadromous fish by the proposed action. (See figure 1).

The HHDR project is located on the Green River in King County, Washington, about 64.5 miles upstream from the mouth of the Green-Duwamish River System (Figure 1). Howard Hanson Dam is about 35 miles southeast of Seattle and about 25 miles east of Tacoma. The project lies entirely within the City of Tacoma's municipal watershed, and is closed to public access.

The Green/Duwamish River Basin covers an area totaling 483 square miles and extends from its highest point (5,750 feet MSL) at Blowout Mountain near Stampede Pass in the Cascade Range to sea level at Elliott Bay in Central Puget Sound. The Green/Duwamish River is about 90 miles long and flows generally in a northwestern direction toward its mouth at Seattle.

The topography and character of the Green/Duwamish River Basin varies dramatically between its headwaters and mouth. The upper watershed is undeveloped and managed almost entirely for timber production. The terrain is generally steep and forested, timbered mainly by conifers except along the river and stream channels where deciduous and mixed forest stands dominate. Few manmade structures confine or restrict the river channels in the upper basin. In the middle basin below the Green River Gorge (River Mile 47) where a noticeable break in the terrain occurs, the Green River reaches the gentle slope of the valley floor. Much of the original forest land has been converted to farmland, and levees increasingly confine the river channel. Most of the lower basin has been highly altered by the clearing of the original forest lands and the filling of freshwater and estuarine wetlands and intertidal flats, and now consists largely of industrial and residential development. The river channel is highly restricted along both banks by levees or rock revetment, and is periodically dredged between its mouth and River Mile 5.5 for navigation.

A detailed description of the basin and the anthropomorphic changes are contained in the Corps' Green/Duwamish Basin Restoration Report and in Fuerstenberg et al. (1996).

PROJECT BACKGROUND

HOWARD HANSON DAM

The dam is an earth-filled structure composed of rolled rock fill, a sand and gravel core, and rock shell protection. The dam is 235 feet high, has a total length of 675 feet, and is 960 feet thick at its base and 23 feet thick at the crest.

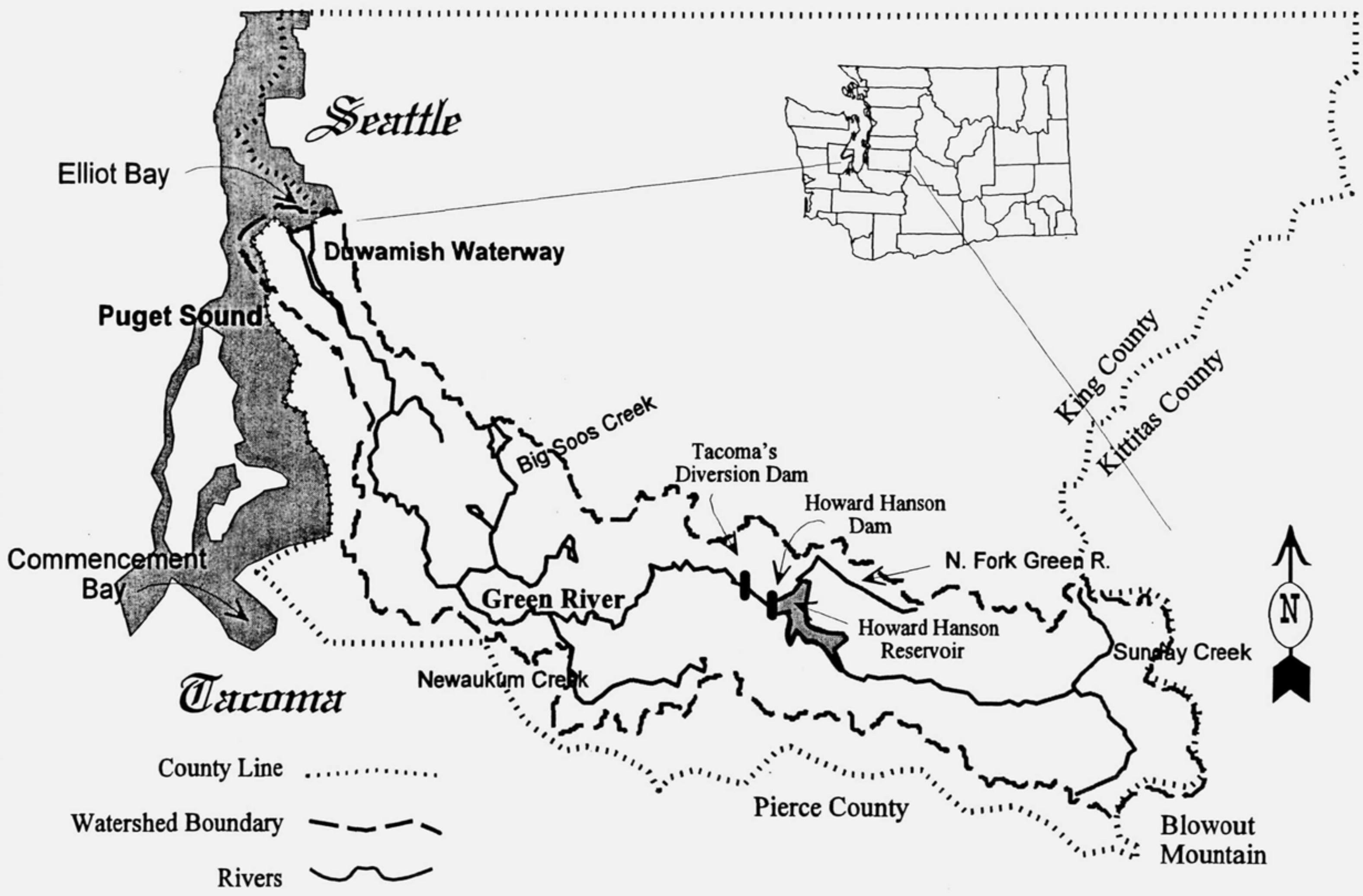

Figure 1. Howard Hanson Additional Water Storage Project Vicinity Map

Regulated releases (non-spill events) are made through either the 19-foot diameter horseshoe shaped tunnel that is controlled by two radial gates at elevation 1,035 feet mean sea level (MSL), or through a 48" diameter bypass pipe at elevation 1,070 feet MSL. The tunnel outlet is used to pass flood flows and flow releases that exceed the capacity of the 48" diameter outlet. Low flow releases during the summer conservation period are made through the bypass pipe. The spillway has not been needed to pass flood flows since the project was constructed.

HOWARD HANSON RESERVOIR

The reservoir is approximately four miles long at its present full conservation pool volume of 25,400 acre-feet, corresponding to a water surface elevation of 1,141 feet MSL. The reservoir is normally filled to its full conservation pool by June 1. At this pool level, the surface area of the reservoir totals 732 acres. The reservoir level recedes over the summer and early fall, as water is released from storage to meet the existing project's minimum instream flow goal of 110 cfs below the Tacoma Diversion Dam. By November 1, the reservoir is essentially emptied to provide for the full flood control capacity of 106,000 acre-feet. To date, only 85 percent of the flood control storage capacity has been needed. As a consequence of flood control regulation during the winter and early spring, the reservoir level fluctuates dramatically, responding to the temporary retention of high flow events from rainfall and snow melt. Releases from HHD are regulated to limit the river flow at the Auburn gage to a maximum of 12,000 cfs during flood events. Although the reservoir could be emptied completely, a minimum storage of about 1,200 acre-feet is retained to avoid the higher turbidity levels that would result from the erosion of the accumulated reservoir sediments.

Since 1962, the Corps has tried several reservoir refill strategies in an effort to address several objectives, including the protection of fish migration, spawning, egg incubation, and water quality, while still meeting its authorized project purposes. Because of the existing operational and physical constraints, none of the strategies have been totally satisfactory from a fishery protection perspective. For example, the Corps has delayed reservoir refill so that outmigrating fish from the upper basin are not forced to sound to great depths to find the outlet to HHD. While this strategy benefits the upper basin migrants, it subsequently causes adverse impacts to spawning steelhead and lower river smolts because of the reduced flows that result later in the season when refill does occur. Delaying reservoir refill means that a greater volume of water must be stored in May if the 25,400 acre-feet target is to be achieved. This time period often coincides with the time frame when runoff is typically receding.

Water quality constraints have occasionally affected the refilling of the reservoir. The Corps and Tacoma presently operate under terms of an agreement which specifies that the existing project will not worsen Tacoma's water quality from pre-dam conditions. Specifically, Tacoma was originally concerned about the potential for the reservoir to retain turbid water and to prolong the period that the water would be unsuitable for its water supply use. In response to Tacoma's concerns, the Corps has occasionally interrupted the refilling of the reservoir to accelerate the flushing of turbid water.

PROPOSED ACTION

The recommended plan includes raising the level of the reservoir to provide 22,400 acre-feet of storage for Tacoma's water supply and 9,600 acre-feet of storage for instream flow augmentation, habitat improvements, a downstream fish passage facility at HHD and measures to mitigate the effect of raising the reservoir pool level.

The project sponsors have proposed a phased approach because of fishery concerns related to the withdrawal of more water from the Green River and the uncertainty of safely passing fish through a larger impoundment. Phase 1 includes the construction of the HHDR fish passage facility, the implementation of a number of habitat restoration elements, and limiting the additional storage in HHDR for Tacoma's water supply to 20,000 acre-feet. Phase 2 involves going forward with the recommended storage plan, or some reduced plan in response to the results of the phase 1 monitoring, as well as the implementation of a number of habitat restoration elements. The implementation of phase 2 would depend on the project sponsors demonstrating to the resource agencies and Muckleshoot Indian Tribe (Tribe) that increasing the size of the reservoir and further reducing the flows in the river during the spring period could be accomplished without impacting the anadromous fish resources.

PHASE 1

Phase1 includes the following elements:

- The addition of ecosystem restoration as an authorized project purpose.
- The storage of up to 20,000 acre-feet for Tacoma's water supply.
- The construction of a downstream fish passage facility at HHD.
- Riparian and stream habitat improvements to mitigate 78.2 and 11.5 acres, respectively, that would be inundated by the higher reservoir pool level.
- Three restoration projects consisting of the annual placement of spawning gravel in the middle reach of the Green River, the reconnection of a side channel near Palmer, and the improvement of stream and river habitats above HHDR to address original project impacts.
- The correction of a seepage problem along the right abutment of the dam.
- The adoption of an adaptive management approach to reservoir refill and release.

- Increases in staffing at HHDR (up to 24 hrs per day, 7 day per week operation would occur during periods of the spring refill/steelhead spawning season, as needed) to allow more precise adjustments in achieving targeted stream flows.

- Establishment of seventy-nine acres of pastures to provide replacement forage for elk.

- Management of about 143 acres of late successional forest (LSF) to include thinning, snag and down wood creation, and under planting.

- Retention of inundated trees between elevation 1,147 feet and 1,167 feet to provide interim snag and perch sites and maintain some of the function of a riparian zone.

- Planting of sixty-nine acres of water tolerant plants such as sedges to provide ground cover and forage in the inundation zone.

- Mitigation for forested wetland and riparian zone losses, focused on creating two subimpoundments near the mouths of Cottonwood Creek and Gale Creek, respectively.

- Management of the abandoned railroad grade to create several sub-impoundments.

- Monitoring and evaluation of project operation on fish and wildlife, as well as a commitment to implement corrective measures, if needed.

<u>The Storage of Tacoma's Pipeline 5 Water Right</u>

Tacoma proposes to store up to 20,000 acre-feet of its existing Pipeline 5 (P5) water right behind Howard Hanson Dam during the February 16 to June 30 period for later use in the summer and fall when its water demand is higher. Tacoma's P5 water right allows it to divert up to 100 cfs, in addition to its P1 water right of 113 cfs, when the minimum instream flow requirements, as specified in its agreement with the Muckleshoot Indian Tribe, are met. Under Phase 1 of the proposed project, the quantity of water Tacoma would be allowed to divert from the Green River would not change, but the timing of when the water is stored and used would be different from the direct diversion and use condition. (See discussion on page 11.)

<u>Downstream Fish Passage</u>

The recommended alternative for providing downstream fish passage at HHD involves the construction of a fish collection and transport facility, designed to operate over the majority of reservoir levels and flows up to 1,250 cfs, the 50 percent daily exceedance flow during April and May. At flows between 1,250 cfs and 1,600 cfs, the fish collection facility could be operated, but it would exceed the fish passage velocity criteria. Operation in this flow range would be contingent upon the monitoring results and evaluation of juvenile fish passage through the facility. Flow in excess of 1,600 cfs would be passed through the existing unscreened radial gate outlets.

The main features of the fish collection and transport facility are: (1) a new intake tower; (2) a floating fish collector that supports a modular-inclined screen; (3) a fish lock for temporary holding, and (4) a fish transport conduit and pipeline for returning fish back to the river.

Riparian and Stream Habitat Improvements to Mitigate Pool Raise Impacts

Four projects are being considered for mitigating the 78.2 acres of riparian forest lands that would be affected by the phase 1 pool raise. These projects consist of leaving trees within the inundation pool, planting water tolerant vegetation, preserving riparian forest at a ratio of five acres preserved for each acre impacted, and managing Tacoma's riparian forest lands to achieve greater fish and wildlife benefits.

Nine stream improvement projects are being considered to mitigate the pool raise impacts to 11.5 acres of stream habitat. The projects include the replacement of culverts, adding boulders and large woody debris to improve habitat diversity, and the planting of vegetation to improve channel stability.

The proposed mitigation and restoration projects are summarized in Appendix A of this document, and presented in detail in the Corps' Feasibility Report and EIS (Section 8, Appendix F).

Habitat Restoration

Three restoration elements are proposed to address a portion of the existing project's impact on spawning gravel availability and stream habitat. Since 1962, HHD has blocked the transport of spawning gravel from the upper basin which has resulted in the armoring of former salmon and steelhead spawning habitats. Over 8 miles of stream and side channel habitat have been inundated by the filling of the reservoir.

Gravel augmentation is proposed to replenish areas presently deficient of suitable substrate for salmon and steelhead spawning, and to halt the channel bed armoring that is extending downstream. The Corps proposes to place a minimum of 3,900 cubic yards of gravel annually to rehabilitate and maintain 400,000 square-feet of spawning habitat in the middle reach of the Green River.

The second restoration element involves reconnecting a former side channel to the main channel in the vicinity of the Tacoma Diversion Dam near Palmer. The reconnected side channel will restore about 3.2 acres of fishery habitat.

The last element consists of a group of stream habitat improvements that would be implemented along 3.5 miles of tributaries within the HHDR flood control pool between elevations 1,177 feet and 1,240 feet MSL. Proposed improvements include the placement of boulders, rootwads and other large woody debris, and riparian zone management for late successional forests.

Adaptive Management

An adaptive management approach to reservoir refill and release is proposed as a project element so that the project can be operated to better address the complex fishery protection and management issues while still meeting the project's flood control and water supply objectives. The decisions would be made jointly through a group process similar to the one that has been used in recent years to address reservoir refill. Group participants would include the Corps, Tacoma, the Service, WDFW, the Muckleshoot Indian Tribe, King County, Trout Unlimited and recreation organizations.

Under the proposed approach, reservoir refill would be spread out over a longer period, would begin much earlier in the year than under the existing operation, and would be weighted toward the beginning of the refill cycle. Refill would start as early as February 16, instead of mid-April, depending on the flood control needs, and would be completed about June 1. With the exception of the February period when flood control constraints limit reservoir storage, the highest refill rate would occur in March (400 cfs), decline to 300 cfs in April, and drop to 200 cfs in May and June. The maximum storage rate, however, would be constrained by the need to maintain semi-monthly determined base flow targets. It is expected that modifications to the proposed operating criteria will be made jointly by the project sponsors, resource agencies and Tribe, as additional information is collected during the project's first phase.

The storage and release of the 5,000 acre-feet for fishery purposes would also be adaptively managed. Under some circumstances, it may be undesirable to store the entire 5,000 acre-feet because the adverse impact to the fishery from storage may exceed the future benefits. The management of the 5,000 acre-feet includes Corps and local sponsor involvement, although the resource agencies and Tribe would ultimately decide on how it is used.

Reservoir storage in excess of the amount authorized by the existing and proposed projects or allowed by Tacoma's P5 water right must be evacuated from the reservoir by June 30. Excess storage could result from unused water stored for artificial freshets releases, accounting updates, or project operation needs such as debris removal. The release of the excess water would be adaptively managed for fishery purposes but constrained by the June 30 evacuation requirement.

Monitoring and Evaluation

Monitoring and evaluation are significant components of the proposed project and will be used as the primary basis for both adaptive management and phase 2 implementation decisions. The uncertainties with regard to fisheries management, fish migration and behavior, as well as the many permutations of flow, reservoir storage, snow pack, and spawner density and location precludes the development of a single project operations plan that would provide satisfactory protection for the Green River's fish and wildlife resources.

The specific monitoring and evaluation elements that would be included as part of the project are described in detail in the Corps' Feasibility Report and EIS (Section 10 of Appendix F, Part 1).

The issues and topics that would be addressed include: (1) juvenile outmigration timing and survival (lower river, reservoir); (2) attraction to and survival through the fish passage facility; (3) side channel accessibility and use; (4) the success of habitat improvement measures; (5) maximum refill rates; (6) base flow targets; (7) flow augmentation to protect steelhead spawning and incubation; (8) predation on juvenile salmonids; (9) the benefit of releasing artificial freshets; and (10) water quality.

The Corps has proposed 15 years of monitoring and evaluation, but acknowledges this time period could be extented, depending on the actual impacts observed. In addition, the monitoring of project facilities and structures would continue beyond this time frame under the Corps' Operations and Maintenance authority. A yearly listing of estimated cost for each monitoring element is included in the Corps' Feasibility Report and EIS. Pre and post-construction monitoring plans are scheduled for development during the plans and specifications (PED) phase between the years, 1999 and 2000.

PHASE 2

The proposed plan anticipates phase 1 lasting between 5 and 8 years. The implementation of phase 2 would depend on the phase 1 monitoring results demonstrating that both the withdrawal and storage of additional water (up to 32,000 acre-feet) would not impact the anadromous fish resources. The phase 2 elements include:

- The storage of up to an additional 2,400 acre-feet for Tacoma's water supply, which would then total 22,400 acre-feet of storage.
- The withdrawal of up to an additional 22,400 acre-feet of water by Tacoma, concurrent with its diversion of 100 cfs for the P5 project.
- The storage of up to 9,600 acre-feet for flow augmentation. The specific use of this water would be determined jointly by the resource agencies and the Tribe.
- Riparian and stream habitat improvements to mitigate 42.1 and 5.9 acres, respectively, that would be inundated by the higher reservoir pool level. Eleven riparian and stream habitat projects have been developed for evaluation in meeting both the phase 1 and phase 2 mitigation requirements. The final selection of specific projects to mitigate the phase 2 impacts will likely be deferred until phase 1 implementation.
- Side channel improvements to mitigate the loss of 8.4 acres. Four side channel mitigation projects are proposed to mitigate this loss; three are located in the middle Green River, one is located in the upper Green River.
- Pasture improvements/creation totaling 10 acres.

- An additional 65 acres to be managed as late successional forest.
- Eighteen acres of sedges to be planted in the upper inundation zone.
- The creation of another sub-impoundment near Elder Creek along with wetland plantings.

ALTERNATIVES

A large number of alternatives has been considered and evaluated during the project planning period that has now exceeded 13 years. Project alternatives will be only cursorily discussed in this report, but are addressed in detail in the Corps' Feasibility Report and EIS.

WATER SUPPLY

The project sponsors have considered a variety of water supply options, including the development of well fields, demand management, water transfers from other systems, and other new storage and/or diversion facilities beside the AWSP. These other water supply alternatives have received only limited attention and development. No attempt has been made by the Service to evaluate other alternatives or compare them to the proposed action.

FISH PASSAGE

Ten downstream fish passage alternatives were developed to the 10 design level for review by the Fish Passage Technical Committee (FPTC) and by the resource agencies and Tribes. The five members of the FPTC were selected by the resource agencies, Tribe, Tacoma and the Corps, and included Ken Bates of the WDFW, Steve Rainey of the NMFS, Ed Donahue of Fish Pro, Inc., Phil Hilgert of R2 Resource Consultants, and Milo Bell, a retired Corps researcher. The range of alternatives included retrofitting the existing outlet, constructing new passage facilities at the dam, constructing a collection facility at the upper end of the reservoir, and combinations or variations of these options. The selection of the preferred alternative was based on (1) the scientific understanding of fish passage needs; (2) the potential for restoring fish runs upstream of HHD; (3) technical feasibility and incremental analysis in meeting the restoration objective; and (4) consistency with the Corps' Ecosystem Restoration Authority.

FISHERY HABITAT MITIGATION/RESTORATION

The project sponsors have developed a single mitigation proposal, consisting of twelve riparian or channel improvement projects to offset the impacts that would result from the AWSP. It is possible that the list may change and require in-kind substitution, if engineering or other constraints affect the feasibility of a specific project.

A description of the proposed projects can be found in Section 4 of the Corps' Feasibility Report and EIS Report and in Appendix F (Part 1).

PHASE 2 STORAGE

The phase 2 proposed storage includes 22,400 acre-feet for Tacoma's water supply and 9,600 acre-feet for fishery flow augmentation purposes. Under Phase 2, Tacoma's water storage would occur concurrently with its direct diversions under its P1 and P5 water rights. The 32,000 acre-feet is considered a maximum storage volume that can be adjusted downward to reflect the phase 1 monitoring and evaluation results.

WILDLIFE MITIGATION

A terrestrial mitigation plan has been developed and reviewed by the project participants and will be the same for each project alternative. Limited habitat types in the project area that will be impacted include elk winter forage, optimal thermal cover, late successional forest and forested wetlands. The Habitat Evaluation Procedure (HEP) as discussed later in the document, was used to identify and quantify specific habitat losses. Target species used for this evaluation were elk, pileated woodpecker, wood duck, and red-backed vole. Twenty-six specific sites have been identified for consideration as mitigation sites in addition to TPU lands that will be managed for mature forest. The site descriptions and proposed restoration measures are in the wildlife resources section.

RELATED ACTIONS

There are several other proposals or actions that are being considered under separate processes or authorities that have a bearing on the proposed project because of their effect on instream flows, fish passage, habitat quality, and spawner escapement.

MUCKLESHOOT INDIAN TRIBE - TACOMA PUBLIC UTILITIES SETTLEMENT AGREEMENT

This agreement removed the Muckleshoot Indian Tribe's objection to Tacoma's proposed Pipeline 5 project, which involves the diversion of an additional 100 cfs from the Green River. Upon construction of the new pipeline, Tacoma is responsible for: (1) funding the construction and operation of a new tribal fish production facility (or monetary compensation at the tribe's prerogative); (2) constructing upstream and downstream fish passage facilities at its diversion dam near Palmer; and (3) curtailing the use of its Pipeline 1 water right, if necessary to meet the minimum instream flow targets, as defined in the agreement. The Muckleshoot Indian Tribe has requested assurances from the Corps, Tacoma, USFWS, NMFS and WDFW that the AWSP and its fish and wildlife mitigation measures will not undermine the MIT-TPU Settlement Agreement intended to mitigate the impacts of the first and second water supply diversions on treaty fish and wildlife.

HOWARD HANSON SECTION 1135 RESTORATION

Under the authority provided by Section 1135 of the 1986 Flood Control Act, the Corps conducted a study of potential modifications to HHD to improve fish and wildlife habitat within the reservoir and downstream from the existing project. The recommended plan was approved for implementation in 1997. Proposed measures include: (1) storing up to an additional 5,000 acre-feet of water for flow augmentation; (2) providing greater protection to the fishery resources by following an adaptive management approach for reservoir refill and release; (3) improving fish and wildlife habitat within the reservoir drawdown zone and tributaries by planting inundation tolerant species and through the placement of coarse woody debris and floating bush piles; (4) improving fish passage on tributaries to HHDR; and (5) enhancing forage for elk. None of these measures have been implemented to date, except for the storage 5,000 acre-feet of water in drought years. The storage of additional water in non-drought years, occurring in four out of five years, has not been implemented.

The storage in HHD would be increased to 30,400 acre-feet for flow augmentation purposes, but the additional 5,000 acre-feet could be used for a wider range of fishery protection purposes, e.g., attraction flows, protection of incubating eggs, etc. The use of the additional water, however, is constrained by the existing TPU-MIT agreement by limiting the spring time use to 2,500 acre-feet while reserving a like amount for low flow augmentation in the summer and fall. The existing 25,400 acre-feet of storage is reserved to insure that the 110 cfs minimum instream flow can be met with a 98 percent reliability. The option to store the additional 5,000 acre-feet in non-drought years would take effect with the implementation of Phase 1 of the AWSP. The annual decision on whether to store additional water during the non-drought years would be coordinated with the project sponsors, but would ultimately be determined jointly by the resource agencies and the Tribe.

GREEN/DUWAMISH RIVER BASIN RESTORATION

Under the Corps' Section 216 Study, the Corps and King County conducted a reconnaissance level basin study for ecosystem restoration opportunities in the Green/Duwamish River Basin. The Corp's primary focus in ecosystem restoration is on those ecological resources and processes that are directly associated with the hydrologic regime of the watershed. The purpose of the study was to identify restoration opportunities of the Green/Duwamish River ecosystem and to evaluate potential restoration strategies. More than 50 restoration options were identified during the reconnaissance phase. Some of the options overlap with those being considered for implementation under the AWSP and may result in substitutions. The Corps has proceeded into the feasibility phase of the study and potentially could construct restoration projects under its Section 216 authority before phase one of the AWSP is implemented.

NATIONAL MARINE FISHERIES SERVICE'S ESA LISTING OF PUGET SOUND FALL CHINOOK SALMON

The National Marine Fisheries Service has proposed that Puget Sound fall chinook salmon be listed as threatened under the provisions of the Endangered Species Act (March 9, 1998 Federal Register). The listing, if it occurs, could result in changes to the current fishery management practices for chinook salmon, as well as possibly restrict and/or prescribe the options for restoring runs upstream of Howard Hanson Dam. For example, greater numbers of adult salmon may be available to return to the upper watershed if the listing results in reduced harvest rates. On the other hand, the listing could limit or preclude supplementation as an option for re-establishing and maintaining the upper basin population. Potentially, the NMFS could preclude the reintroduction of chinook salmon above HHD if the mortality rate from reservoir passage is concluded to be too high. It is unknown at this time what conservation measures would be required in the event chinook salmon are listed.

The Corps and Tacoma have initiated discussions with the National Marine Fisheries Service NMFS) regarding the proposed listing of Puget Sound fall chinook salmon. Tacoma has indicated it would like to develop a Habitat Conservation Plan to address the relevant issues early in the process. The Corps is expected to request conferencing with NMFS for the same reason.

BIOLOGICAL RESOURCES

FISHERY RESOURCES

At least 47 species of fish are known to use the Green/Duwamish River, based on the fish surveys conducted by Masuda, et al. (1968), Meyer et al. (1980), USFS (1996), Warner and Fritz (1995), Wunderlich and Toal (1992). They include anadromous, freshwater, estuarine and marine species. Table 1.

Anadromous fish species known or expected to occur in the system include chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), chum salmon (*Oncorhynchus keta*), pink salmon (*O. gorbuscha*), steelhead (*O. mykiss*) and sea-run cutthroat trout (*O. clarki*) and sea-run char (*Salvelinus* spp.). Naturally spawning populations returning to the Green/Duwamish system have all declined dramatically in response to the loss of habitat and/or overfishing. Major losses of habitat occurred with the filling of the Duwamish Estuary, channelization, levee construction, and the construction of the Tacoma Diversion Dam. Presently, significant numbers of chinook, coho and chum salmon and steelhead trout are released from State and Tribal hatcheries.

Fall chinook salmon are managed for natural production, with an escapement goal of 5,800 fish. Spawner escapement has averaged about 7,600 fish and has ranged between 5,000 and 10,500 fish (Warner et al. 1995). Significant numbers of hatchery fish are released annually from the WDFW Green River Hatchery (3.2 million young-of-the-year and 300,000 yearlings) and the Tribe's Keta Creek Hatchery (up to 2 million young-of-the-year). The hatchery component is believed to equal or exceed the naturally produced component of the total run (Hage unpublished). In recent years, between 500,000 and 1.8 million chinook salmon have been planted annually upstream of HHD (Hickey 1996). Spring chinook salmon occur now in only very low numbers.

Green River coho salmon are essentially managed as a hatchery stock, even though there is a natural escapement goal of 8,700 fish. As a consequence of the higher harvest rate, the natural escapement goal is rarely met. The run size has ranged between 3,000 and 23,000 fish and is maintained primarily through hatchery releases (Warner et al. 1995). The Tribe's Keta Creek Hatchery produces about 600,000 yearling and up to 2 million young-of-the-year coho, annually. About 500,000 yearlings are also produced at the WDFW Green River Hatchery. In recent years, between 485,000 and 1.3 million coho salmon have been planted annually upstream of HHD (Hickey 1996).

Green River chum salmon runs are supported by both natural and hatchery production. The combined run size has averaged a few thousand fish, which is markedly smaller than the run size of over 11,000 estimated by Williams et al. (1975) from the mid-70's, or Fuerstenberg's et al. (1996) annual escapement estimate of 12,750 for the 1938 to 1942 period. In the last few years, however, chum salmon escapement surveys conducted by the Muckleshoot Indian Tribe have placed the run at over 10,000 fish, annually. A minimum of 500,000 chum salmon fry are released annually from the Keta Creek Hatchery.

Pink salmon (*O. gorbuscha*) historically used the system but have dropped to such low numbers that they are now functionally extinct from an ecological perspective. Pink salmon have not returned in large numbers since the 1930's (Warner et al. 1995).

The Green River supports both a summer and winter run of steelhead, and is one of the top steelhead producing streams in western Washington. The winter population is larger and is composed of both a hatchery and wild stock. About 220,000 hatchery smolts, originally derived from Chambers Creek stock, are released annually from the WDFW's Palmer Hatchery. In addition, up to 90,000 smolts are produced at the Tribe's Keta Creek Hatchery. In recent years, between 55,000 and 84,000 steelhead have been planted upstream of HHD (Hickey 1996). The wild run is considered healthy, and because of its different spawning timing, does not interbreed with the hatchery stock to a significant degree. The escapement goal for the wild run is 2,000 fish. Between 1975 and 1985, the total run size of wild and hatchery stocks, combined, has averaged 11,000 annually (Grette and Salo 1986). Since 1988, the total run size has declined to an average of about 4,700 fish (Cropp 1996). The summer run originated from plants of Skamania steelhead smolts beginning in 1965, and is maintained by the annual release of about 80,000 hatchery smolts. The summer run catch (sport and tribal) has ranged from a low of 396 in 1991 to a high of 3,461 in 1981 (Cropp 1996).

Table 1 Fish species found in the Green/ Duwamish River

Common Name	Scientific Name	Common Name	Scientific Name
Chum salmon	*Oncorhynchus keta*	Northern sculpin	*Icelinus borealis*
Coho salmon	*O. kisutch*	Sharpnose sculpin	*Clinocottus acuticeps*
Chinook salmon	*O. tshawytscha*	Surf smelt	*Hypomesus pretiousus*
Pink salmon	*O. gorbuscha*	Pacific herring	*Clupea harengus pallasi*
Sockeye salmon	*O. nerka*	Shiner perch	*Cymatogaster aggregata*
Steelhead trout	*O. mykiss*	Striped seaperch	*Embiotoca lateralis*
Cutthroat trout	*O. clarkii*	Pile perch	*Rhacochilus vacca*
Dolly Varden	*Salvelinus malma*	Longfin smelt	*Spirinchus thaleichthys*
Bull trout	*S. confluentus*	Threespine stickleback	*Gasterosteus aculeatus*
Brook trout	*S. fontinalis*	Pacific snake blenny	*Lumpenus sagitta*
Mountain whitefish	*Prosopium williamsoni*	Crescent gunnel	*Pholis laeta*
Largescale sucker	*Catastomus macrocheilus*	Saddleback gunnel	*P. ornata*
Longnose sucker	*Catastomus catastomus*	Penpoint gunnel	*Apodichthys flavidus*
Pacific lamprey	*Lampetra tridentata*	Bay goby	*Lepidogobius lepidus*
Western brook lamprey	*Lampetra richardsoni*	Bay pipefish	*Syngnathus griseolineatus*
River lamprey	*Lampetra ayresi*	Walleye pollock	*Theragra chalcogrammus*
Longnose dace	*Rhinichthys cataractae*	Pacific tomcod	*Microgadus proximus*
Speckled dace	*R. osculus*	Starry flounder	*Platichthys stellatus*
Northern squawfish	*Ptychocheilus oregonensis*	English sole	*Parophrys vetulus*
Prickly sculpin	*Cottus asper*	Butter sole	*Isopsetta isolepis*
Torrent sculpin	*Cottus rhotheus*	Hybrid sole	*Inopsetts ischyra*
Riffle sculpin	*Cottus gulosus*	Sand sole	*Psettichthys*
Pacific staghorn sculpin	*Leptocottus armatus*	Pacific sandlance	*Ammodytes hexapterus*
Buffalo sculpin	*Enophrys bison*		

Information is very limited on abundance and distribution of sea-run cutthroat trout, Dolly Varden and bull trout. Historically, the Green River is believed to have supported large numbers of each of these species (Grette and Salo 1986) but now supports remnant populations at best.

The use of the Duwamish-Green River systems by marine and estuarine fish species occurs primarily within the lower 10 miles, although some species like starry flounder that have a tolerance for freshwater, may use habitats upstream of the saltwater wedge. The saltwater wedge can extend upstream to R.M. 10 during low runoff and high tides (Santos and Stoner 1972 in Corps 1995a). More than twenty estuarine and marine species occur in the lower river, including surf smelt, Pacific herring, pile perch, Pacific tomcod, and starry flounder.

The Green River and its tributaries upstream of HHD support` resident populations of rainbow trout, cutthroat trout, mountain whitefish, and several species of sculpins. Brook trout are also known to occur in Page Mill Pond and Page Mill Creek. There is no evidence to support a conclusion that bull trout presently occur upstream of Howard Hanson Dam, based on stream surveys conducted by the U.S. Forest Service, the USFWS, and the Plum Creek Corporation (Goetz, pers. comm., 1996).

Adult steelhead and juvenile chinook and coho salmon and steelhead have been planted upstream of HHD to take advantage of the underutilized spawning and rearing habitat. Wild or naturally produced adult steelhead, numbering between 20 and 133, have been collected at the fish trap at Tacoma's diversion dam since 1992, and released upstream of HHD. In recent years, between 500,000 and 1.8 million chinook salmon, 485,000 to 1.3 million coho salmon, and 55,000 to 84,000 steelhead juveniles (i.e., fry, yearlings, presmolts) have been planted annually upstream of Howard Hanson Reservoir (Hickey 1996).

A more detailed description of the Green/Duwamish River's fishery resources, including a historical perspective, can be found in Appendix F of the Corps' Feasibility Report and EIS for the AWSP, the Corps' Green/Duwamish River Basin Restoration Report, and in Fuerstenberg, et al. 1996.

WILDLIFE AND BOTANICAL RESOURCES

The wildlife in the project area are species that are commonly associated with lowland coniferous and deciduous forests of western Washington. This report will discuss only selected species of high interest to the project participants. Information on wildlife use within the project area is limited to the qualitative observations made by federal and state wildlife biologists, and Tacoma Public Utilities and Corps personnel.

Elk

Elk (*Cervus elaphus*) are the largest animal in the Green River watershed. The watershed is a prime habitat for hundreds of elk. A limited harvest is allowed in the area that helps assure a high success rate. Special harvest regulations are in place that allow bulls to attain a larger average size. These "trophy" animals make the special permits highly sought after by recreational hunters. Because of these reasons, elk have received the greatest attention of the wildlife using the project area. Important areas of the high quality wintering habitat and critical calving grounds, especially near the McDonald farm will be impacted by this project.

Elk counts have been conducted for several years in the upper Green River. Data from pre and post hunting season counts included herd numbers, compositions, and locations. The data showed that the river bottom lands and old homestead farms such as McDonald's farm and Baldi field are important foraging areas for elk. Sixty to 70 elk use the farm for summer range. The number of elk increases substantially during the winter because of elk migrating into the area for winter range.

McDonald's farm and Baldi field are located on the north shore of the reservoir with a mainly southern aspect. Both are located in Sec. 35, T21N, R08E, with Baldi field being slightly west and north of McDonald's farm.

A 1994 mark/recapture population estimate (Gove 1994) placed the Green River watershed herd at 612 elk. This estimate was completed after the fall hunting season and therefore reflects a reduction in numbers due to hunting mortality. Raedeke and Associates (1995) calculated a pre-hunt total of 734 animals by adding in the harvest numbers, and the assumed losses to wounding and winter kill. More recent information has indicated that the population has crashed to about 225 animals.

The elk that use the project vicinity may range outside of the Green River watershed into the Cedar River basin to the north and the Greenwater River basin to the south. The project affects only the landbase immediately adjacent to the reservoir but may affect the way in which elk utilize the available habitat. Any mitigation or restoration of elk habitat will need to keep in mind the migration patterns of these animals.

Many studies have described elk habitat in Western Washington. Several major types of habitats are recognized in these studies. They include forage, cover (hiding, thermal, and optimum thermal), and breeding and calving habitats. In lands managed for timber production, such as the project area, the limiting factor for elk is usually optimal thermal cover or winter range.

Raedeke and Associates (1996) proposed a modified version of the Wisdom model (Wisdom *et. al.1986)* for use as a basis to assess impacts to elk. This modified model was adopted by the HEP team and used for the development of the project mitigation proposal. It defines three types of cover: optimal thermal cover, thermal cover and hiding cover.

Optimal thermal cover is extremely important in providing winter range. It is defined as forested areas that have an average diameter at breast height (dbh) of 21" and 70 percent or greater canopy closure. Usually found in old growth forests, the larger limbs and canopy cover prevent a snow buildup on the ground by sublimation and interception of snow. Ground forage is available through the winter due to the lack of snow buildup. These forest stand conditions also modify the ambient temperatures by keeping the area warmer in winter and cooler in summer. There is little optimal thermal cover in the area immediately surrounding the reservoir.

Winter range can also be provided in areas with a southern aspect at low elevation. These areas maintain a warmer microclimate in the winter and provide high quality forage during most of the winter season. This type of winter range component is found within the project boundary at McDonald's farm and other similar areas.

Thermal cover can modify extremes in temperatures but may not provide forage in winter due to a lack of effective snow interception. Canopy closure is at least 70 % but tree height can be as short as 40'.

Shorter vegetation such as shrub-scrub and saplings provides hiding cover that elk can use to escape human disturbance. The tree density is such that sight distances are reduced significantly. It usually does not provide climate modification or forage.

Elk Exclosure Cages and Pellet Group Transects

The importance of the vacated farmed meadow (McDonald's farmsite) to elk as a foraging site is well known. It is likely that most of the site would be destroyed by the proposed pool raise. A vegetative study was completed during fiscal year 1994 to quantify this loss. The data collected in fiscal year 1994 answered the question of what kind of forage is growing on the meadow area. To answer the question of how much forage exists, it was proposed to construct and deploy elk exclosure cages on McDonald's farm and the Baldi field pastures.

In December 1995, Corps personnel, two volunteers, and a Service biologist constructed 10 elk exclosure cages. The exclosures were cone shaped and constructed out of wire mesh. In February 1996, five exclosures were installed in the different plant community types on each pasture area before the beginning of the growing season.

Placement location was selected to avoid exclosures being too close to each other and to sample different vegetative communities within the pasture. Details of the entire project will be found in Appendix F (part two) of the Corps' Feasibility Report and EIS.

The caged-plot vegetation was sampled by clipping. The clippings were analyzed and compared with elk pellet content analysis. This data is key to determining what the elk are eating compared with availability.

In plant communities along the shoreline, various species of sedge grow in small patches. Elk browsed some sedge species more than others. It was speculated that this may be due to elk seeking out certain minerals contained in those particular sedges. To decide if this was occurring, an analysis of the mineral content of the different sedge species and other forage is being conducted by the Wildlife Habitat Laboratory, at Washington State University.

The most interesting information to date is that the ash content in plants at McDonald's farm is three times higher than it is in Baldi field. This high ash content may be causing some malnutrition in the elk since ash inhibits the elk digestive system. A nutritionist from the Starkey Range Experiment Station indicated that this ash may be a result of surface grit on the plants (Ken Brunner 1998 personal communications). This type of ash tends to pass through the digestive tract of elk without being utilized and thus causes no problems to the animal.

Other Mammals

Cougar (*Felis concolor*) studies have been conducted for several years in the vicinity including the upper Green River watershed. Concentrations of cougars occur in the vicinity of McDonald's farm probably due to the abundant elk and deer in the area. The cougar population in the area is reported to be one of the highest densities in the United States (Spencer 1996 cited in COE 1996). The population is estimated at about 15 cougars, which are preying on a population base of just over 1200 deer and elk. A similar number of cougars (15 - 20) are found in the Yellowstone area where they prey on around 21,000 deer and elk.

Other large mammals known or likely to occur within the project include: black-tailed deer (*Odocoileus hemionus*), and black bear (*Ursus americanus*).

Furbearers in the project area include beaver (*Castor canadensis*), river otter (*Lutra canadensis*), mink (*Mustela vison*), raccoon (*Procyon lotor*), coyote (*Canus latrans*), muskrat (*Ondatra zibethicus*), marten (*Martes americana*), weasels (*Mustela* spp.), and red fox (*Vulpes vulpes*). Other small mammals include Douglas squirrel (*Tamiasciurus douglasii*), Townsend chipmunk (*Eutamius townsendi*), deer mice (*Peromyscus maniculatus*), red-backed voles (*Clethrionomys gapperi*), pika (*Ochotona princeps*), snowshoe hare (*Lepus americanus*), shrews and moles.

Birds

Waterfowl of many varieties are common on the lake during the spring and fall migration seasons. Mallards (*Anas platyrhynchos*), Canada geese (*Branta canadensis*), and American widgeons (*Anas americana*) have been seen feeding and resting on the grassy area of McDonald's farm. Wood duck (*Aix sponsa*), green-winged teal (*Anas crecca*), and northern pintails (*Anas acuta*) have been observed on the reservoir. Hooded mergansers (*Lophodytes cucullatus*) and common mergansers (*Mergus merganser*) are common. Wintering waterfowl include common goldeneyes (*Bucephala clangula*), ring-necked duck (*Aythya collaris*) and bufflehead (*Bucephala albeola*). Many of these waterfowl may nest near the reservoir.

Harlequin ducks (*Histrionicus histrionicus*) are ocean ducks that breed along larger fast moving streams, often miles from the ocean. Breeding harlequins have been observed between Howard Hanson dam and the headworks reservoir. They may nest near the reservoir but most information about nesting behavior shows that they prefer heavily vegetated riparian zones near fast moving water.

Common loons (*Gavia immer*) were observed nesting in Howard Hanson in the early 1990s and again in 1997 (Brunner pers. com). The WDFW has placed loon nesting platforms on the reservoir since 1993. Nesting habitat has been successfully developed using these techniques just to the north in the Cedar River watershed. It is likely that with enhancement efforts aimed specifically at loons, successful nesting may occur more frequently.

Raptors found within the project boundary include red-tailed hawk (*Buteo jamaicensis*), Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*Accipter striatus*), and several owl species. Bald eagles (*Haliaeetus leucocephalus*) have been seen foraging at the reservoir. No nests are known to occur immediately around the reservoir at this time.

Ospreys *(Pandion haliaetus)* have been seen foraging at the reservoir each year. They have not nested along the reservoir but nesting has been observed along the Green River between Howard Hanson dam and the headworks. If mitigation measures (such as leaving snags within the inundation zone and anadromous fish reintroduction) are successful, it is likely that ospreys will begin nesting near the lake.

Many other birds use the area. Golden eagles (*Aquila chrysaetos*) have been observed over Grass Mountain and Huckleberry Mountain south of the project about 4 -6 miles. Great blue herons (*Ardea herodias*), belted kingfishers (*Ceryle alcyon*), western flycatchers (*Empidonax difficilis*), black-capped chickadees *(Parus atricapillus*), and violet green swallows (*Tachycineta thalassina*) are common. Ten species of warblers, three species of vireos and five species of woodpeckers have also been observed (COE 1996).

Amphibians

Amphibians observed within the project include the Pacific chorus frog (*Pseudacris regilla*), the Cascade frog (*Rana cascadae*) and the red-legged frog (*Rana aurora*). The Pacific chorus frog has been observed rearing in the reservoir. Other amphibians that may be affected by the proposed project include rough-skinned newts (*Taricha ganulosa*), Northwest salamanders (*Ambystoma gracile*), and Western toads (*Bufo boreas*). These species typically reproduce in slow moving or still water. Several, such as the Pacific chorus frog and the Western toad, use ephemeral ponds.

Reservoir edges with sufficient aquatic and terrestrial vegetation may be used by these species for reproduction and rearing. Breeding and egg laying by most of these species occurs in midwinter to late spring depending on the elevation and latitude. In particular, Northwest salamanders, and red-legged frogs lay eggs in water less than 3 feet deep. Incubation times vary depending on water temperature. Amphibians using the project area may breed from late February through May. Early spring surveys around the lake perimeter have found egg masses for both Northwestern salamanders and red-legged frogs (Aitken, 1997a, pers. com.).

Tailed frogs (*Ascaphus truei*) are inhabitants of fast flowing cold mountain streams. The larval period may last from 2 to 3 years depending on location. The first year tadpoles prefer temperatures <10° C while the 2nd year tadpoles prefer a warmer 10 - 22°C (De Laming and Bury 1970). Several streams within the project area exhibit these characteristics and may contain tailed frogs. Upper watershed amphibian surveys found tailed frogs in several tributaries to the Green River.

Several amphibian surveys were conducted in the upper watershed during 1997 by Service and Plum Creek biologists (Levy 1997 per. com.). The most common species found was the western red-backed salamander *(Plethodon vehiculum)*. Ensatinas were also found during these surveys. Several Larch Mountain salamanders (*Plethodon dunni*) were positively identified in a proposed Plum Creek harvest unit during the spring of 1997. Three additional Larch Mountain salamander sites were found during subsequent surveys (Tate 1997 pers. com).

Threatened and Endangered Species

In a letter dated January 22, 1996, the Service identified five federally listed animal species and two candidate species that may occur in the project vicinity. Included in this list were the bald eagle (*Haliaeetus leucocephalus*), marbled murrelet (*Brachyramphus marmoratus marmoratus*), northern spotted owl *(Strix occidentalis caurina)*, gray wolf (*Canis lupus*) and grizzly bear (*Ursus arctos*). Spotted frogs (*Rana pretiosa*) and bull trout (*Salvelinus confluentus*) were listed as candidate species. Of these species, only the bald eagle has actually been observed within the project boundary or within the Green River riparian corridor downstream from HHDR. Up to four bald eagles have been observed within the vicinity of the reservoir, and use of this area occurs throughout the year. There are no known bald eagle nest sites near the project.

HABITAT TYPES

The project area is in the western hemlock vegetation zone. Most of the forested project lands, however, are deciduous or mixed deciduous/coniferous. In the deciduous forests along the streams and flatter parts of the reservoir perimeter, red alder (*Alnus rubra*) dominates with inclusions of big-leaf maple (*Acer macrophyllum*) and black cottonwood (*Populus trichocarpa*). Mixed deciduous/coniferous forests include western hemlock *(Tsuga heterophylla)* and western red cedar (*Thuja plicata*). In most of the younger coniferous forest, Douglas fir (*Pseudotsuga menziesii*) is the dominant tree species because of extensive reforestation on harvest units. Various densities of naturally regenerated western hemlock and western red cedar occur as a component in the upland stands. Western hemlock, the climax species, is rarely dominant because of fire and reforestation efforts. Older stands that were established during a less intensive management era are dominated by western hemlock.

Timber harvest in the upper Green River has been extensive. It started in the 1880s and continues to this day. All of the stands within the project have been logged at least once. The oldest stands date from 1888 although most stands are much younger than this (see Table 2).

Table 2. Age distribution of forest cover-types on City of Tacoma Lands near Howard Hanson Dam and Reservoir(adapted from Raedeke Associates 1996) Includes all forested land that Tacoma owns.

Age Class (Years)	Deciduous and Coniferous Forests (Acres)	Percent of Total Area	Cumulative Percent of Total Area
1	591	6	6
10	415	4	10
20	1141	12	22
30	578	6	28
40	562	6	34
50	570	6	40
60	990	11	51
70	2063	22	73
80	1560	17	90
90	522	6	96
100	383	4	100
Total	9375	100	

The cover types occurring within the inundation zone of the reservoir include deciduous, coniferous, and mixed forest stands; forested and scrub-shrub wetlands; emergent marsh; mudflats; grasslands; and talus slope/rock. (See Table 3). These cover types were used in the Habitat Evaluation Procedures (HEP) study, which was conducted in 1986 and then suspended. The study was later reinitiated, with a draft report published in 1994 and most recently updated in 1996 (Brunner personal communication).

Table 3. Revised area of cover-types in the HEP Study Area, Howard Hanson Dam, Additional Water Storage Project. (adapted from Raedeke Associates 1996)					
Cover-type	Code	Study Area (acres) [1]	Existing Reservoir Area (acres) [2]	Inundated Area (acres) [3]	Upland Area (acres) [4]
Conifer Forest	FC	48.76	0.37	22.17	26.19
Young Conifer	FCY	12.49	0.0	0.0	12.49
Young Conifer and Grass	FCY/G	9.77	0.0	.68	9.09
Young Conifer and Shrub	FCY/S	27.31	0.0	13.66	13.65
Deciduous Forest	FD	468.40	12.90	194.75	260.75
Deciduous Forest - Alder	FD-1	108.84	.64	52.90	55.30
Deciduous Forest - Cottonwood	FD-2	14.30	0.0	7.01	7.29
Young Deciduous Forest	FDY	34.99	.58	16.21	18.20
Young Deciduous Forest & Grass	FDY/G	20.29	0.0	.34	19.95
Mixed Forest	FM	218.68	4.65	95.87	118.16
Grass	G	29.14	1.9	15.82	11.42
Grass and Shrubs	G/S	2.51	0.0	.79	1.72
Shrub	S	5.6	0.0	1.02	4.58
Palustrine Forest	PFO	15.03	1.12	12.19	1.72
Scrub/Shrub	PFF	16.88	7.7	7.42	1.76
Inundated Grass	PEM	125.76	108.48	17.26	.02
Mudflat	MF	62.57	53.13	9.43	.01
Moss and Quack Grass	FL	81.51	81.31	.20	0.0
Open Water	POW	487.99	435.96	26.23	25.80
River Channel	R	28.4	.05	2.64	25.71
River Bed	RB	42.86	22.42	9.69	10.57
Talus Rock	T	11.61	1.09	4.62	5.9
Total		**1873.69**	**732.3**	**510.9**	**630.28**

[1] Habitats below El. 1220 feet. ~Minimum elevation of inundated habitats is approximately El. 1070 feet, the winter flood pool level. (Upstream of the dam only)

[2] Habitats below El. 1141 feet, the surface of the Conservation Pool.

[3] Habitats between El. 1141 feet and El. 1 177 feet, the proposed Conservation Pool with Phase 2 implemented. El. 1180 has been used in some determinations.

[4] Habitats between El. 1177 feet and El. 1220 feet

Source: Ryan, 1995. Areas revised following HEP Team visit, spring 1995.

(Note all of these acreages are estimates from orthophotos and GIS maps.)

FUTURE WITHOUT THE PROJECT

The Service has assumed the following conditions for our "future without the project" analysis:

- HDR will not be retrofitted with fish passage improvements.
- The Corps' future operation of HHDR will incorporate the knowledge gained from the planning of the AWSP and will also include the refinement of the rule curve used for meeting the 98% reliability of the 110 cfs minimum flow.
- Reservoir refill will begin earlier and will be adaptively managed for the protection of the lower river fishery resources.
- The storage of an additional 5,000 acre-feet for fishery protection uses will be implemented under the Corps' Section 1135 authority.
- Juvenile chinook and coho salmon, and steelhead trout will not be planted upstream of HHDR.
- Tacoma will fully develop its P5 water right and implement the provisions of the TPU/Tribe Agreement.
- At least some of the habitat restoration projects proposed under the AWSP will be implemented.
- Puget Sound fall chinook will receive additional protection, either through an ESA listing by the NMFS or by implementation of the WDFW wild salmonid policy.

FISHERY RESOURCES UPSTREAM OF HHDR

Without the AWSP and the significant fish passage improvements it would provide at HHDR, the Service concludes that only resident fish species (rainbow and cutthroat trout, mountain whitefish, and sculpins) would utilize reservoir, mainstem and tributary habitats upstream of HHDR. It is unlikely that WDFW, Tribe or Trout Unlimited would continue their programs of planting significant numbers of chinook and coho salmon and steelhead trout upstream of HHDR because of the poor fish survival through the dam and the entrapment of smolts within the reservoir.

Fish passage studies conducted by the Service (Dilley and Wunderlich 1992, 1993) indicate that juvenile chinook and coho salmon exiting the reservoir through the higher outlet suffer high injury or mortality rates. Mortality and injury rates, combined, typically exceeded 50 percent. Too few steelhead were collected to conduct an analysis, but given their surface orientation and large size as smolts, they can be expected to have similar or even higher mortality and injury rates.

The large radial gate outlets at the bottom of the dam were assumed to cause less injury because of their greater flow capacity and absence of sharp angles within the structure. The Service studies confirm that fish exiting the reservoir through the radial gates have high survival and low injury rates (Dilley and Wunderlich 1992, 1993). However, these outlets are often closed or deeply submerged by late spring. Even when the gates are open, significant numbers of chinook and coho salmon are trapped in the reservoir because they are either unable to find, or are unwilling to descend the more than 90 foot depth to reach, the radial gate outlets. Juvenile coho and chinook salmon and steelhead trout typically occupy the upper portion of the Howard Hanson Reservoir water column (Dilley 1993, 1994, Cropp undated). Elevated ATPase levels from chinook and coho salmon smolts taken from the reservoir throughout the summer indicate that these fish were physically ready for their entry into the marine environment, but were unable to exit during their normal migration period (Dilley and Wunderlich 1992, 1993). It is generally believed that fish that migrate outside their normal "window of opportunity" survive poorly because they are out of sync with their prey resources and the environmental conditions to which they have evolved (Bilton et al. 1982, Holtby et al. 1989).

FISHERY RESOURCES DOWNSTREAM OF HHDR

The primary concern expressed by the resource agencies and Tribe is the effect of future HHDR operation and Tacoma's P5 water right withdrawal on chinook, coho and chum salmon and steelhead. These factors are also expected to impact the estuarine, marine and resident fish using the lower river and the Duwamish estuary, but the consequences are poorly understood. Consequently, the discussions in this report will be directed toward evaluating the project's impact on anadromous fish.

On the basis of the "without the project" assumptions discussed later, we conclude the anadromous fish stocks will remain at current levels or increase slightly. Gains resulting from improving the HHDR mode of operation, basin restoration efforts, and higher minimum instream flows would offset the losses resulting from future development in the watershed and additional withdrawals under Tacoma's P5 water right. The consequence of an Endangered Species Act (ESA) listing or implementation of the WDFW's wild salmonid policy on the numbers of salmon and steelhead returning to the Green River is open to debate. But given the increasing emphasis on protecting and restoring naturally reproducing populations of salmon and steelhead, it is reasonable to expect that greater numbers of fish will be allowed to spawn naturally in the river. This may require the marking of all hatchery fish, the use of selective fishing gear that allows the release of wild fish, or further harvest restrictions. We assume hatchery production will remain at current levels, but recognize it could easily change because of constraints related to ESA or the WDFW's wild salmonid policy.

The primary factors affecting the fishery resources downstream of HHDR are:

- Fishery management decisions by the WDFW and the Tribe.

- Habitat modifications resulting from water diversions, development, restoration, and the operation of HHDR.

The future management of the Green/Duwamish fishery resources by the WDFW and Tribe is unclear. The issues relating to harvest management, including allocation and natural versus hatchery production, are complicated and agreement has not been reached between WDFW and the Tribe over the details of future management. The Service, however, has assumed in this report that either the WDFW's "Wild Salmonid Policy" will be implemented or the NMFS will list Puget Sound fall chinook salmon under the provisions of the ESA. Either of these actions would result in greater emphasis on natural production, and could result in greater numbers of naturally produced fish. Hatchery production, however, could decline if the fishery managers or the NMFS conclude that the current level of production adversely affects the naturally produced stocks.

In the absence of the AWSP, we have assumed that Tacoma would still fully develop its P5 water right. The development of alternative storage options, e.g. well field recharge like the Oasis Project, would likely delay full utilization of Tacoma's P5 water right. We made no attempt in this report to predict the length of the delay for inclusion in our analysis. Given the large numbers of people moving into the Puget Sound area, and the increased demand for new water supplies, we assumed the delay factor would be small and therefore insignificant over the long term. Therefore, the effects of Tacoma's P5 water right on the lower river's flows and fishery resources are considered to be essentially the same under both the "future with the project" and "future without the project" conditions.

Upon Tacoma's full use of its P5 water right, flows downstream from its diversion dam will generally be lowered by 100 cfs during the winter and spring from current conditions. This flow reduction will negatively impact chinook salmon juveniles because survival has been shown to be positively correlated with higher migration flow (Wetherall 1971, Warner et al. 1996). A similar relationship is likely for chum salmon. In contrast, juvenile coho salmon and steelhead trout, and adult chinook salmon should benefit from the higher summertime and early fall base flows, required by Tacoma's P5 settlement agreement with the Tribe. In very dry years, Tacoma is required to curtail withdrawals under its P1 water right to insure that the base flows are maintained.

Lower river fish populations will continue to be impacted by losses of habitat, independent of the AWSP, as more people move into the Puget Sound region, placing additional demands on land and water. On the other hand, habitat improvement measures like those proposed in the Green/Duwamish Basin Restoration Project would offset some of the habitat loss caused by future development. Cancellation of the AWSP would mean that this project's habitat restoration elements (including spawning gravel augmentation and side channel reconnection) would require an alternative funding source for implementation.

The Corps has stated it would be willing to refine its refill rule curve to incorporate the new information developed during the planning of the AWSP. The Service believes a refined rule curve or set of curves to define refill rates under various hydrologic conditions would result in fewer flow related impacts to the fishery resources when compared to existing conditions. Presently, the Corps allows considerable flexibility on both the rate and start of refill but is strict on requiring that refill be completed no later than June 1 to insure that the 110 cfs minimum instream flow can be met with a 98 percent reliability. Although the 98 percent reliability would be maintained, the storage volume or completion date could be adjusted, if supported by further analysis, to allow more flexibility to protect the fishery resources. Greater flexibility to manage the lower river flows would also occur because it would no longer be necessary to delay reservoir refill to provide upper basin migrants with better dam passage conditions.

WILDLIFE AND VEGETATION RESOURCES

Forest succession will change the habitat type and plant species composition over time. The City of Tacoma has published a forest land management plan (TLMP) that prescribes various timber management treatments (Ryan 1996) on Tacoma's forested land base. The TLMP has divided Tacoma's holdings into three management zones: the natural management zone, the conservation management zone, and the commercial management zone. Vegetative manipulation in these zones will also change the habitat quantity and quality in the project area.

Forest management of the natural zone will be directed at preserving the vegetative cover and developing old growth habitat for associated wildlife species. It contains 3,779 acres. Six stands older than 180 years (old growth) with a total of 62 acres are located within this zone. There will be no timber harvest within this zone.

Management in the conservation zone is directed at maintaining or improving vegetative cover for fish and wildlife habitat. This zone contains a total of 3,000 acres. It lies between commercial forest lands and the natural zone to buffer it from areas of intensive forest management which may impact wildlife habitat or water quality. The long-term goal is to develop mature multi-storied forest stands. Timber harvest of up to 41 acres annually may be conducted to manipulate habitat and the animals dependent on it.

Forest management in the commercial zone will be directed at maximizing timber volume within environmental constraints at a sustainable level. This zone contains a total of 2,246 acres. Up to 39 acres per year could be harvested in this zone.

Most of the following discussion (except where specifically noted) assumes that the TLMP will be adopted. The reason for this is that without the management scenarios presented in the TLMP, the assumption would be that timber harvest would be the primary goal of the forested land base. Mitigation for three of the target species, wood duck, pileated woodpecker, and the red tree vole, would be difficult if not impossible. With the plan's emphasis on recreating "old growth" conditions in the natural and conservation zones, mitigation for these species is feasible.

To assess impacts to wildlife species, the Habitat Evaluation Procedure (HEP) was used. This is a habitat-based method for accounting for wildlife habitat data that allows a comparison of existing habitat condition with a prediction of future conditions. This methodology helps to identify potential impacts and assess needed mitigation measures of a particular project. A detailed description of the HEP is contained in Ecological Services Manual ESM 102 (USFWS 1980).

Due to concern by the HEP team about the adequacy of available elk models, Raedeke Associates Inc. was hired to develop a modified elk model that would better fit the Green River watershed situation. Raedeke's (1994) approach used a modified Wisdom model (Wisdom et al. 1986), to assign generalized forage values to specific vegetation types.

Details of the HEP can be found in several documents. The first is *A Review of the Habitat Evaluation Procedures: Howard Hanson Reservoir* (Resources Northwest 1991). The second is the Corps' October 12, 1994 second draft of the HEP analysis, *Howard Hanson Dam Additional Water Supply Habitat Evaluation Procedures (HEP)*. The third is the draft of the wildlife appendix to the COE's EIS on the *Howard Hanson Dam Additional Water Supply Project.* Information discussed below is drawn from these and other documents. The elk model and its use in developing mitigation can be review in detail in *Mitigation Concepts for Terrestrial Wildlife* (Raedeke 1996).

Indicator species are those used in the HEP analysis to indicate (or represent) the habitat. These species also represent a guild of species that use the same habitat in similar ways. Ten indicator (evaluation) species (see Table 4) were selected for the study.

Table 4. Indicator Species and Habitat Types Represented by Them

SPECIES	HABITAT TYPES (also called cover types)
Pacific Chorus (Tree) Frog *(Pseudacris regilla)*	all habitat types listed
Green-winged Teal *(Anas carolinensis)*	FMM; FM; FCM; FCY; FDM; FDY; PEM; S; G;
Sharp-shinned Hawk *(Accipiter striatus)*	FMM; FM; FCM; PFO;
Downy Woodpecker *(Picoides pubescens)*	FMM; FM; FCM; FCY; FDM; FDY; PFO; PSS;
Pileated Woodpecker *(Dryocopus pileatus)*	FMM; FM; FCM; FDM; PFO;
Black-capped Chickadee (Parus atricapillus)	FMM; FM; FCM; FCY; FDM; FDY; PFO; PSS;
Mink (*Mustela vison*)	all habitat types within 100 meters of stream and reservoir
Douglas Squirrel (*Tamiasciurus douglasii*)	FMM; FM; FCM; PFO;
Red-backed Vole *(Clethrionomys gapperi)*	FMM; FM; FCM; FCY;
Rocky Mountain Elk *(Cervus canadensis)*	all habitat types listed
Wood Duck *(Aix sponsa)*	PFO
Species in shaded boxes are also target	

Habitat types are: FC = mature conifer; FCY = young conifer; FD = mature deciduous; FDY = young deciduous; FM= mixed forest =; PFO = palustrine forest (forested wetland); PSS = shrub swamp; PEM = emergent marsh; S = upland shrub; G = upland grassland; FMM = managed mature forest; FCM= mitigation site mature conifer; FDM= mitigation site mature deciduous.

Target species are species that are selected for a more in depth analysis or for mitigation needs because of the potential impact of the project on them. They are also selected because of their biological uniqueness or because they are important to the public. The target species for this project are the pileated woodpecker, red-back vole, Rocky Mountain elk, and wood duck (See Table 4). These species will be used to measure mitigation results for this project.

For the HEP analysis, the Corps has assumed that TLMP is not in effect and that 50 acres of timber harvest will occur each year on Tacoma lands in the HEP analysis area. HEP is an accounting system and in order to show the actual effects of the mitigation efforts it was necessary to set a baseline without the TLMP. The HEP tables will therefore show a mitigation gain over the current conditions which would have been largely masked by the effects of TLMP. Table 5 shows the AAHUs for the 4 target species based on these assumptions.

The effect of natural succession and habitat manipulation can make predictions of future animal use and impacts difficult. Since the project lies within the natural and conservation zones, the changes are mostly subtle and small in magnitude. The major elk grazing areas of McDonald's farm and the adjacent emergent wetlands will not show any significant changes. The forested openings will be lost over time as forest encroaches on the meadows and the canopy kills out the understory. The rights of way (ROW) will be managed for short vegetation and will gradually convert into a cover type dominated by shrubs with less forbs available. Thermal cover and optimal thermal cover will gradually increase throughout the natural and conservation zones.

Table 5. Habitat Units and AAHUs for project area without the Project. Assumes 50 acres of timber harvest each year. (TY = Target Year)

	Habitat Units					
Target Species	TY 0	TY 1	TY 10	TY 25	TY 50	AAHUs
Elk	237	277	245	260	281	268
Red Backed Vole	344	304	471	611	697	561
Pileated Woodpecker	486	439	475	1085	924	832
Wood Duck	6.6	6.6	6.6	6.6	6.6	6.6

Without the TLMP, speculation as to the fate of thermal and optimal thermal cover is problematic. If TPU does not manage their lands, but simply allows natural succession to proceed, optimal thermal cover development will be a slow process and may take 50 - 150 years to completely develop the multi-story canopy and diverse understory characterized by optimal thermal cover. If Tacoma manages their entire holdings for timber production, then thermal and optimal thermal cover will likely never develop.

The development of optimal thermal cover may be faster with Tacoma's proposed management within the natural and conservation zones. This management should also increase some of the old growth characteristics. The timber harvest in the commercial zone will significantly reduce the potential for old growth to develop due to the short rotational age proposed. It will also reduce the value of the natural and conservation zones for species that require large unfragmented habitat blocks.

Tacoma's TLMP implements timber harvest in the conservation zone only to benefit "wildlife". Since wildlife species vary widely in their habitat requirements the goal for one species may be quite different from another. If the goal is increasing elk and deer forage, then the loss of forested openings will be compensated by creating additional forage. If the goal is to recreate late successional forests, then forage may become limiting in future years.

The above discussion also applies to the other groups of animals that use the project area. Waterfowl and shorebirds will likely not see any change to their preferred habitat in the foreseeable future. The habitat for furbearers and other small mammals should not change significantly from the current condition. Animals that use old growth or mature forests may find more suitable habitat in time. Amphibian habitat should not change significantly over current conditions.

Riparian zone conditions will remain fairly static. The main change in the future will be an increase in the conifer component in the overstory and a reduction of deciduous overstory trees. Species that use the present riparian zones will continue to have this habitat available.

Snags within the proposed project boundary will increase both in size and in number over time. As the forest area matures, the closing canopy will kill smaller trees and provide snags of smaller diameter. Larger trees will begin to die as disease and insects attack the weaker trees and larger snags will result.

The four target species' HSI scores for the area without the project are shown in Table 6. Target year 0 represents the habitat value as it exists. TY10 shows the habitat value 10 years in the future. As discussed above, the changes in HSI scores for the area without the project are very minor. They show a minor increase in habitat value for the red-back vole and pileated woodpecker due to their heavy dependence on mature and old growth forest conditions.

Table 6. HSI scores for the target species at Target Year (TY0, TY 10,and TY 50) without the project.

Cover Type	Rocky Mountain Elk			Red-backed Vole			Pileated Woodpecker			Wood Duck		
	TY0	TY10	TY50	TY0	TY10	TY50	TY0	TY10	TY50	TY0	TY10	TY50
FC (mature conifer)	.1	.1	.1	.63	.63	.8	0	0.1	1	0	0	0
FCY (young conifer)	.25	.25	.25	.01	.01	.01	0	0	0	0	0	0
FD (mature deciduous)	.1	.1	.1	0	0	0	0	0.1	.4	0	0	0
FDY(young deciduous)	.25	.25	.25	0	0	0	0	0	0	0	0	0
FM (mixed forest)	.1	.1	.1	.18	.18	.18	.95	.95	1	0	0	0
FO (forested swamp)	.1	.1	.1	0	0	0	.45	.45	.45	0.5	0.5	0.5
SS (shrub swamp)	.25	.25	.25	0	0	0	0	0	0	0	0	0
EM (emergent marsh)	.5	.5	.5	0	0	0	0	0	0	0	0	0
S (upland shrub)	.25	.25	.25	0	0	0	0	0	0	0	0	0
G (upland grass)	.5	.5	.5	0	0	0	0	0	0	0	0	0

FUTURE WITH THE PROJECT

The Service believes it is premature to address phase two of the project at this time with regard to the fishery resources because the effects of withdrawing and storing more water need to be based largely on the monitoring and evaluation that will be conducted during phase one. Consequently, the following discussion is limited to the assessment of the phase one conditions.

The Service has assumed the following "future with the project" conditions in our analysis:

- Fish passage improvements at HHDR and Tacoma's diversion dam will be effective.
- Reservoir refill and release will be managed adaptively to protect and enhance the river fishery resources while facilitating fish passage through the reservoir and dam.
- Staff will be available to operate the project on a 24 hour, 7 day per week basis during reservoir refill and periods when operational changes are critical for fishery protection.
- Reservoir refill will be allowed to begin by February 15 with an allowable storage volume of between 3,000 and 5,000 acre-feet by the end of February.
- Target flows, preliminary 900, 750, and 575 cfs for wet, normal and dry years, respectively, have a higher withdrawal priority than Tacoma's P5 water right.
- Puget Sound fall chinook will receive additional protection, either through an ESA listing by the NMFS or by implementation of the WDFW wild salmonid policy.
- Permanent hatchery augmentation will not be precluded by the listing of Puget Sound fall chinook salmon.
- Trees in the expanded conservation pool, i.e., between elevations 1,141 and 1,177 feet MSL, will not be removed.
- The habitat improvement measures (mitigation and restoration) will be implemented.
- Lower river flows will not be impacted because of water quality constraints, i.e., turbidity.
- Tacoma's potential water quality concerns will not preclude the transport and release of sufficient numbers of adult steelhead and salmon to achieve the restoration objectives for the upper basin.

FISHERY RESOURCES UPSTREAM OF HHDR

The construction of a state-of-the-art fish passage facility at HHDR, in conjunction with the passage improvements that would be implemented at the Tacoma Diversion Dam under the TPU-Tribe agreement, is expected to solve the structural fish passage problems and facilitate the restoration of chinook and coho salmon and steelhead trout populations above HHDR. Sea-run cutthroat and Dolly Varden char should also benefit, but little is known about their current status in the basin, and therefore, it is difficult to predict how long it would take for these populations to respond. Smolt passage success through a larger reservoir and harvest management decisions that affect spawner escapement are the two main uncertainties relative to the restoration of self-sustaining populations of chinook and coho salmon and steelhead. Consequently, the restoration prospect is considered favorable for steelhead, fair for coho salmon and poor for chinook salmon, unless there is a significant change in the harvest management strategy.

The favorable restoration rating for steelhead is based on the low harvest rate on wild fish and because the juvenile outmigrants are expected to traverse Howard Hanson Reservoir and sustain only low mortality because of their larger size and greater swimming ability. The lower rating for coho salmon is related to the high harvest rates that presently occur in marine waters and in the Green/Duwamish system. The restoration of a self sustaining population would depend on reducing the harvest rate from the higher hatchery rate to the lower wild stock rate. On the favorable side, coho smolts are also relatively large and should sustain only minor mortality as they migrate through the reservoir. The restoration potential of chinook salmon in the upper basin is considered poor mainly because of potentially high reservoir passage mortality, habitat degradation from timber harvest and road construction, and because of the potential reluctance of one or both of the resource managers to lower the current harvest rate. The majority of chinook salmon juveniles migrate at less than one year of age when they are much smaller than either steelhead or coho salmon smolts. Consequently, reservoir passage mortality may be significant, but it is impossible to quantify because survival is dependent on the quality of rearing habitat in the reservoir, predator and prey abundance, transportation flows through the reservoir, and other factors.

Representatives from Tacoma have stated that Tacoma would like to harvest the merchantable timber in the enlarged conservation pool but would not proceed unless they could show this action would not adversely impact the fishery restoration efforts. The Service, other resource agencies and the Tribe have participated in discussions with Tacoma and stated the importance of leaving the trees to improve the survival of juvenile fish rearing and migrating through the reservoir. Trees, or large woody debris after they die from the higher pool, would provide escape cover, more surface area for attachment for aquatic insects, and greater diversity of habitat. The merchantable timber, primarily the larger conifers, are the same trees that are expected to provide the greatest fishery benefits over the long term because of their size, resistance to decay, and retention on site (Cowardin 1969, Burns and Dahlgren 1983, Gingrich 1997).

The proposed project would restore safe passage to at least 106 miles of former anadromous fish habitat and include habitat improvements along 3.5 miles of tributary habitat. While essentially all of the habitat upstream of HHDR is unaffected by residential or commercial development, significant degradation of fish habitat has resulted from timber harvest and road construction. The impacts (e.g., sedimentation, channel migration, scarcity of large woody debris, and elevated water temperature) from past timber harvest and road building will continue to affect recovery for years into the future. While the stream corridor will receive greater protection under current regulations and habitat conservation plans, the short rotation harvest of privately owned timber is expected to continue for several decades (U.S. Forest Service 1996). Over the long term, the Service is optimistic that the increasing emphasis on habitat protection and restoration will eventually result in significant improvements in the forest management practices and recovery of the upper basin.

The Corps has developed a range of anadromous fish production estimates for the upper watershed using a number of accepted methodologies, as well as corroborating their results against historic counts and estimates from other studies. The Service is comfortable with the Corps approach, given the stated assumptions in the Feasibility Report and EIS along with the understanding that the production estimates should not be considered absolute, but rather a basis from which to compare the fish passage alternatives. We believe the Corps' approach is appropriate for this stated purpose and for providing a common ground for discussing the potential production from the upper watershed. For this purpose, the Corps has made the production estimates shown in Table 7.

We believe significant changes in the current harvest management strategies for chinook and coho salmon would be necessary for these escapement levels to be reached under the self-sustaining and natural production approach. While these estimates could be improved by refining the parameters of the models used, it is unlikely that the additional effort would lead to different conclusions. The reader is directed to Appendix F of the Corps' Feasibility Report and EIS for the specific details on which the production estimates were based.

Table 7. Potential production potential of salmon and steelhead in the upper Green River and escapement goal necessary to sustain populations.

Species	Smolts	Adult Escapement
Coho	161,000	6,500
Steelhead	25,000	1,350
Fall Chinook	890,000	2,300

The escapement estimates have significant harvest management implications. The goal of restoring self-sustaining populations of anadromous fish is not possible for chinook and coho salmon, but likely for steelhead, under the current harvest management strategies. The natural production objective for Green River chinook salmon and the low numbers of harvestable wild or naturally produced fish has resulted in harvest management problems and disagreements between the Tribe and WDFW. The creation of self sustaining runs above HHDR would add to the problem by requiring additional harvest restrictions to protect the upper river stocks, which would likely become the weak stocks of the basin.

The goal of restoring self-sustaining populations of chinook and coho salmon may need to be relaxed if sufficient escapement to the upper basin cannot be achieved through a combination of habitat restoration and the reduction of sports, commercial and tribal harvest. Under this potential outcome, the USFWS would support the use of appropriate supplementation techniques to restore and maintain the upper basin runs, if supplementation is determined to be consistent with the NMFS' ESA recovery objectives.

The proposed fish passage facility includes design features that are intended to reduce the mortality associated with dam passage to less than 5%, a significant reduction from the "without the project" mortality rate that typically exceeds 50%. In addition, the surface intake should eliminate the entrapment of smolts in the reservoir that currently occurs because existing outlets become deeply submerged.

FISHERY RESOURCES DOWNSTREAM OF HHDR

The AWSP provides much greater flexibility in the management of instream flows by: (1) expanding the HHDR project's authorization to include resource protection as a project purpose; (2) eliminating or at least reducing the need to delay refill; (3) dedicating an additional 5,000 acre-feet of storage for fish protection; (4) including the "dampened dam" provision; (5) increasing the period that staff at HHDR would be available to make adjustments at the dam; and (6) relaxing the water quality constraints. The Service believes these factors, in addition to establishing target flows, would result in significant improvements in the flow regime and benefit to the downstream fishery resources, when compared to the "future without the project" conditions.

The existing project authorization is limited to insuring that 110 cfs is maintained with a 98 percent reliability, and therefore, does not allow for any discretionary use such as flow augmentation for protecting steelhead incubation. In addition, the priority on storing sufficient water for flow augmentation has caused flows in the lower river to drop so dramatically that steelhead redds have become dewatered (Engman, 1997 personal communication). The expansion of the authorized project purpose to include resource protection would give the resource agencies and the Tribe a greater role in decisions involving resource risks and tradeoffs.

The construction of a fish passage facility with a surface intake would eliminate the need to hold the reservoir level below 1,100 feet MSL until April 15th to assist fish in finding the exit to the reservoir. Without this constraint, the refilling of the reservoir could start earlier, resulting in a storage volume that is well above the refill rule curve, and preclude the need to make major increases in the storage rate to achieve full refill. For these reasons, we believe the flow fluctuation impacts to steelhead spawning and incubation would be reduced in both magnitude and frequency. Although this conclusion relies on the assumption that steelhead smolt survival will not be significantly reduced by their passage through the larger reservoir and thereby preclude early refill, we believe it is a likely assumption. Steelhead smolts are relatively large and have the swimming capability of migrating through the enlarged Howard Hanson Reservoir in one or two days.

The target flows of 900, 750, and 575 cfs for wet, normal and dry years, respectively, should provide valuable instream protection, but they are too low to address other important fishery issues such as juvenile outmigration and side channel connectivity.

The dedication of another 5,000 acre-feet of storage in non-drought years would provide additional fishery resource protection. For example, this water could be used for augmenting flows in the spring to assist steelhead spawning and incubation, in the fall to benefit chinook migration and spawning, or to create spring freshets to improve juvenile outmigration.

The Corps has also proposed an operational concept known as the "dampened dam" which has the potential to benefit both lower and upper river fishery resources. In concept, any undedicated water that is stored in the reservoir would be placed in the dampened dam account and be held either for fishery resource protection or to make up storage deficits in the dedicated accounts (P5 and 110 cfs minimum flow) that resulted from actions taken to protect fish, but were not actually required by agreements or permits. For example, the dampened dam account could be used to maintain a stable flow to protect steelhead spawning during periods when Tacoma meets the conditions for withdrawing its P5 water right. Or, water from the dampened dam account could be released to maintain desired base flows or to create freshets when natural runoff is insufficient. The dampened dam concept was tried on a test basis during the spring of 1998 to evaluate the effect of releasing artificial freshets on side channel utilization and juvenile outmigration. Preliminary results suggest that artificial freshets may be a useful tool in stimulating juvenile outmigration. While the storage of water in the dampened dam account does not come without risks to the fishery resources, we believe the benefits outweigh the impacts.

The staffing level at HHDR would increase under the proposed project to include both night time and weekend coverage during the refill and crucial release periods. The ability to make more frequent flow adjustments would provide for the preservation of the natural hydrograph as well as the implementation of more flexible refill strategies to protect fish in the lower river and to assist smolt migration through the reservoir.

The Corps and Tacoma have an existing agreement that specifies that the operation of the project (original project) will not impact Tacoma's water supply. As a consequence of this agreement, the Corps has occasionally released the turbid water from storage or has delayed reservoir refill to allow turbid inflows to pass through the reservoir. The downstream fishery resources have been impacted by the resulting fluctuations in river flow. During the AWSP discussions, the FWS and other resource agencies have requested that the existing practice of dumping or passing turbid water be changed. In response, Tacoma has stated that if actions that are taken to address its water quality concerns preclude storage, the lost storage will be deducted from its P5 account. This commitment is important because in its absence, the dumping or passing of turbid water through the reservoir would likely result in more frequent and severe flow fluctuations. Without this commitment, refill rates would need to be increased to make up for the precluded or lost storage volumes. Fishery resources would be most severely impacted if the storage makeup occurred in late spring after most of the runoff had occurred. The Service is satisfied that once this commitment is formalized, it will provide the needed assurance that the fishery resources will not bear the burden of addressing Tacoma's water quality issues.

WILDLIFE AND VEGETATION RESOURCES

The following discussion assumes that the Service recommendations are adopted and mitigation is successful. It also assumes that Phase 1 and Phase 2 impacts are similar in nature and differ only in the severity of those impacts. The recommendations of the Service are discussed later in this document and are intended to reduce the project impacts to terrestrial wildlife as much as possible. They are based on our understanding of the mitigation plan proposed by the Corps.

Phase 1 of the project will raise the level of the pool 20' to an elevation of ~1167' MSL and will inundate 255 acres of terrestrial habitat. Phase 2 of the project will raise the pool another 8 feet and will inundate another 148 acres (See Table 8). Inundation to these levels would occur over much of the growing season.

Major habitat types affected from Phase 1 would include emergent, shrub-scrub, and forested wetlands (90 acres, see note 1 Table 8), grassland and upland shrub (13 acres), mature deciduous forest (148 acres), mixed forest (49 acres), young deciduous forest (11 acres), young coniferous forest (1 acre) and mature coniferous forest (14 acres). Total forested area lost will equal approximately 230 acres. In Phase 2 additional habitat will be lost. Acreages of the major habitat types inundated will include wetlands (6 acres), grassland and upland shrub (3 acres), and forested habitat (144 acres).

The tree species that will be inundated (Douglas fir, Sitka spruce, western hemlock, western red cedar, black cottonwood, red alder, and big-leaf maple) will not survive within the inundation zone. Consequently, the proposed action would result in the loss of about 374 acres of forested habitats if both phases are implemented. This will adversely affect wildlife species (e.g., northern saw-whet owl, Townsend's warbler, Douglas squirrel) that are dependent on or prefer these habitats. Two of the HEP target species, pileated woodpecker and red-backed vole, will be impacted by this habitat loss.

The resultant habitat will probably consist of mud flats with some moss development and an unknown amount of emergent wetlands around the edges of the inundation zone. Some new habitats may evolve consisting largely of snags, sedges, rushes, grasses, and perhaps some shrub species, e.g. willows. This will benefit wildlife, such as cavity nesting birds, waterfowl, and amphibians, in the short term. Other species like black-tailed deer and elk, while losing cover or hiding habitat, may gain foraging habitat.

Table 8. Phase 1 and Phase 2 Habitat Area Impacts (these numbers are approximate and may change)			
Cover Type	**Acres Inundated by Phase 1**	**Acres Inundated by Phase 2**	**Total Acres Inundated by the project**
Mature Conifer	14	6	20
Young Conifer	1	14	15
Total Conifer	**15**	**20**	**35**
Mature Deciduous	148	86	234
Young Deciduous	11	5	16
Total Deciduous	**159**	**91**	**250**
Mixed Forest	49	28	77
Forested Wetland	7	5	12
Total Forested [3]	**230**	**144**	**374**
Shrub-Scrub Wetland	2	1	3
Emergent Wetland	10 [1]	0	10
Forested Wetland	7	5	12
Total Wetland [3]	**19**	**6**	**25**
Upland Shrub	1.5	1	2.5
Grassland	11.5	2	13.5
Total Habitat Lost [2]	**255**	**148**	**403**

[1] Vegetation on as many as 90 acres may be killed because of the effects of inundation.

[2] These figures differ from COE data because several cover types, i.e. riverbed and open water, were not included in this table.

[3] Forested wetlands are included in both the forested and wetland totals.

ELK

One of the species most impacted by this project would be elk. Elk graze heavily on the upper grass meadows in MacDonald farm. The emergent wetland vegetation in the upper reservoir is also heavily used. Deer use these areas to a lesser degree but along with elk use the natural forest openings and clear-cut areas for forage. The power line right of way (ROW) that is artificially maintained as grass/shrub habitat is heavily used by elk. The forage quality in the forest is rated low due to the lack of understory vegetation. Heavy canopy closure prevents the development of understory vegetation that can be used as forage. To mitigate for these losses, a number of actions will be implemented.

Mitigation for elk winter forage will focus on managing existing habitats to increase the habitat value. For example, intensive management (e.g. mowing and fertilizing) of existing grasslands should increase forage productivity. Converting forest stands to grass to achieve the goal of increased forage production will also be used.

Optimal thermal cover and late successional forests share many physical traits in common and can be enhanced by similar techniques. Thinning second growth forest stands will increase light to the forest floor and allow midstory and understory communities to develop. Increasing the amount of woody debris on the forest floor and creating snags would also help to move the forest stands toward a late successional stage.

For Phase 1, five sites (79 acres) were selected to be developed or managed as elk meadows. Five other sites would be developed as emergent wetlands to provide seasonal elk forage.

Sites 1, 2, 7, and 8, (Site numbers found in Appendix B) are located within an existing powerline right-of-way and maintained in grass and shrub habitat. Adjacent forest habitat would be converted to elk meadows at several of these sites. All of these areas would be managed as "tame" pastures (described in detail in Raedeke, 1996). Tame pastures would be plowed, seeded, fertilized and mowed as needed. Site 5 is adjacent to Baldi Field (an existing natural meadow area). Eighteen acres at this site would be converted to "tame" pasture habitat.

Sites 22, 23, 24 and 25 are located in the upper limits of the new conservation pool. Site 16 on the south side of the reservoir is a deciduous forest that would die as a result of the pool raise. At each of these sites, shallow marsh vegetation would be developed in the upper reservoir elevation zone by planting inflated sedge *(Carex vesicaria*), Kellogg sedge *(C. lenticularis*), and Columbia sedge *(C. aperta*). Approximately 69 acres of emergent vegetation would provide early spring forage opportunities for elk. These sedges have been shown to survive various lengths of time submerged during the growing season.

Several acres would be managed for accelerated late-successional characteristics that would eventually provide optimal thermal cover for elk during extreme winter weather. These sites are identified under the pileated woodpecker discussion for both Phase 1 and 2.

In Phase 2, one elk meadow site would be developed to mitigate for the additional lost elk forage. Site 3 is a powerline right-of-way site that would be managed to provide 10 acres of "tame" pastures.

Except for the more inundation tolerant Columbia sedge, the sedge communities established for Phase 1 mitigation would be lost at Phase 2. Phase 2 mitigation would include re-establishment of 18 acres of sedges in the upper inundation zone. Sites 11, 23, 24 and 25 would be used to establish this acreage.

With the proposed elk mitigation, the resulting elk habitat may be of sufficient quality and quantity to offset the loss created by the project (Table 9). The assumption underlying this and the other mitigation proposals is that the techniques and methods used to create the projected increase in habitat quality or quantity are effective. The proposed mitigation achieves slightly more than a 1:1

ratio for AAHUs. This is usually the goal of a HEP analysis. Since the above assumption has not been proven for this site, the Service believes that monitoring results between phase 1 and phase 2 should determine if additional mitigation will be needed during the phase 2. If the expected results are achieved, we will be satisfied with the mitigation as proposed.

Table 9. Elk Habitat Value comparison between existing conditions, Phase 1, and Phase 2. (These numbers are approximate and may change in the future. They assume no TPU Land Management Plan in effect)

	Project Area Impact in lost AAHUs	AAHUs created by mitigation	Resulting Elk AAHUs (Mitigation - Impact)
Phase 1	78.09	81.96	3.87
Phase 2	27.85	30.37	2.52
Total	105.94	112.33	6.39

PILEATED WOODPECKERS, RED TREE VOLES AND OTHER LATE SUCCESSIONAL DEPENDENT SPECIES

Several species were chosen in the HEP to represent late-successional forest conditions. For the analysis and mitigation planning, pileated woodpecker and red tree vole, both target species, were used. Pileated woodpecker represents primary cavity nesters that need larger diameter snags (> 20-inches diameter) in a variety of decay stages. Optimum conditions for the red-back vole are considered to be mature coniferous forest with at least 60 percent canopy cover and 20 percent or more of the forest floor covered with woody debris at least 4" in diameter. The existing stands in the project area have very little downed woody debris. The average woody debris coverage was estimated to be approximately five percent.

Characteristics that are important to other late-successional dependent species include a multilevel and multi-species canopy dominated by large trees and a significant number of large broken top trees. The multi-layered canopy of different tree species increases the vertical diversity and results in many habitat niches for dependent species. These conditions also make the stand optimal thermal cover for deer and elk.

Mitigation for loss of potential or actual late-successional forest can be achieved using a variety of techniques. These techniques would be used in combinations on a site specific basis. Unless monitoring results or new information dictates, the techniques would remain the same for phase 1 and phase 2. These techniques are summarized as follows:

- Thin even-age class stands to stimulate mid-story and understory species development.

- Create and manage snags:

  Provide snags in small groups across the landscape, rather than a uniform distribution.

  Provide snags in a variety of size classes, decay classes, tree species and locations.

  Manage for natural snag development.

- Place downed woody debris:

  Provide coarse woody debris in a variety or size and decay classes.

  Select various methods of snag creation to provide a varied rate of downed woody material.

- Treat soil by adding lime and/or fertilizer.

- Selectively underplant shade tolerant tree species to accelerate development of a midstory canopy.

- Manage areas dominated by deciduous tree species to replace the deciduous species with conifers.

Sites 9, 10, 12, 13, 15, 18, 19 and 26 will be managed for late successional forest between the North Fork Green River and Gale Creek and on selected areas south of the reservoir. Stands along the Green River upstream of the reservoir may also be managed for late successional characteristics for fish mitigation. These stands will be incorporated into the total area dedicated to late successional management adjacent to the reservoir.

In the second phase, 65 acres of mixed and mature coniferous forest, on sites 14 and 26, will be managed for late successional characteristics. This may include riparian stands along the mainstem Green River upstream of the reservoir.

Mitigation for pileated woodpecker and red-backed vole would result in an increase in habitat after phase 1 is accomplished (Table 10). The loss of AAHUs for both species after phase 2 is completed is significantly greater than that gained by mitigation. The models for these two species is heavily dependent on large snags and downed woody debris.

Red-backed voles benefit primarily by the additional downed wood that decays and provides additional food resources. After Phase 2, the red-backed vole AAHUs are just marginally greater than the number lost. As we discussed previously, the assumptions about mitigation techniques have not been proven on site and could result in much less mitigation than our analysis shows. This is especially true in trying to re-create late forest succession (LSF) conditions in an even aged stand. For this reason, we encourage the Corps and TPU to explore additional mitigation measures to allow for error in the assumptions. This may not be possible to achieve because of the limited amount of LSF in the project vicinity, but mitigation should at least approach a ratio of 1:1 AAHUs lost versus gained.

Table 10. Pileated Woodpecker and Red-backed Vole (RV) Habitat Value comparison between existing conditions, Phase 1, and Phase 2. (assumes that the TPU Land Management Plan is not in effect)						
	Project Area Impact in lost AAHUs		AAHUs created by mitigation		Resulting AAHUs (Mitigation - Impact)	
	Pileated Woodpecker	Red-backed Vole	Pileated Woodpecker	Red-backed Vole	Pileated Woodpecker	Red-backed Vole
Phase 1	174.82	73.51	184.22	131.23	9.4	57.72
Phase 2	99.71	58.28	4.99	10.93	-94.72	-47.35
Total	274.53	131.79	189.21	142.16	-85.32	10.37

The pileated woodpecker analysis shows a serious decline in Phase 2 AAHUs. This unmitigated habitat loss is a concern to the Service since the pileated woodpecker functions as a keystone species. The large holes it excavates are used by many other species for nesting and den sites. The other late successional forest characteristics that are important to pileated woodpeckers are also key characteristics for many other species. We believe that in order to achieve mitigation, Tacoma should explore their entire land base in the upper Green River for potential mitigation sites.

Snag creation is not a hard science and useable snags can be difficult to create. Erecting artificial snags (large diameter dead trees) may be possible and may help to achieve a more balanced mitigation result. It is imperative that an intensive monitoring effort be accomplished between phase 1 and phase 2. Monitoring results should indicate which techniques to create snags are successful and to what degree predictions about snag usage are fulfilled.

Late successional forests are by definition mature to old-growth forest and do not develop in the short term. The 50 year project time frame used in this analysis may not substantially increase all of the characteristics for which the stands are being managed. However, the progression of these stands from younger seral stages to mature or even old growth conditions will provide niches for a wide variety of wildlife species. Other late successional dependent species will benefit from this type of management over the long term.

WOOD DUCKS AND OTHER FORESTED WETLAND/RIPARIAN ZONE SPECIES

Using the wood duck as a target species, almost 6 AAHUs would be lost in Phase 1 and 2. Mitigation by constructing and managing the subimpoundments gives an increase of almost 6 AAHUs in Phase 1 (Table 11). In Phase 2, the AAHUs lost are greater than the gain from mitigation for a net loss of almost 2 AAHUs. There is a net gain of almost 4 AAHUs between Phase 1 and Phase 2.

Seven acres of forested wetland and a substantial but unquantified amount of riparian zone habitat will be lost or impacted by the project. A total of 89 acres of wetland will be inundated during most of the growing season and as a result will be unavailable for use by wildlife. The year around value of both wetlands and riparian zones will be diminished by inundation due to the changes of diversity.

Inundation and reservoir fluctuation will prevent development of a diverse riparian zone. Riparian zone habitat values will be further reduced on tributary streams that flow into the reservoir. Since very few riparian zone plant species can survive inundation during the growing season, the complex nature of the riparian zone with its diverse plant species and habitat niches will be lost. Some of this value will remain at the upper edges of the inundation zone but most will become a very simple ecosystem with little habitat diversity.

Table 11. Wood Duck Habitat Value comparison between existing conditions, Phase 1, and Phase 2. (assumes no TPU Land Management Plan in effect)

	Project Area Impact in lost AAHUs	AAHUs created by mitigation	Resulting AAHUs (Mitigation - Impact)
Phase 1	3.31	9.18	5.87
Phase 2	2.43	.53	-1.9
Total	5.74	9.71	3.97

During the winter drawdown, the inundation zone will have almost no habitat value. It will create a barrier to movement for many animal species, especially smaller land bound species. Lack of ready water access reduces the value of the remaining riparian zone significantly. The drawdown and fluctuation may interfere with nutrient cycling and food webs. Deterioration of primary productivity may affect the food chain up to the top terrestrial predators.

Amphibian breeding may occur as early as February in the project vicinity. During this time the reservoir pool elevation will be drawn down for flood control and the resultant bare lake bed may prevent or inhibit movement of amphibians to and from the water edge for egg laying. If amphibians like the northwest salamander or red-legged frog do access the water for spawning, refilling the pool may create water conditions that reduce hatching or survival of the juveniles. Water temperatures and depth may change during the incubation period and create conditions that are detrimental to larval survival. Predator population may increase because of changes in water level conditions. The reservoir may act as a population sink if amphibians are drawn to the water for reproduction and the refill causes significant mortality.

Furbearers begin bearing young in late winter to early spring, during drawdown. The drawdown zone may interfere with this reproductive cycle. If denning sites are selected along the edge of the water zone, refill may flood burrows or make dens more accessible to predators due to the lack of vegetative cover.

Mitigation for riparian zone habitat loss would be monitored by both wildlife and fishery groups due to the high value for both groups of species. Riparian zone habitat would be restored or enhanced following the fishery mitigation plan. Forested wetland sites would be developed by creating sub-impoundments adjacent to forested areas. Snags and nest boxes would be created within and adjacent to the impoundments. The objective is to create stable water levels to promote aquatic plants and encourage use by birds, mammals, and amphibians. A stable water level would also encourage the development of a more diverse riparian zone adjacent to the subimpoundments.

THREATENED AND ENDANGERED SPECIES

The Corps addressed the AWSP's potential to impact federally listed species in its biological assessment, dated January 15, 1998. The Service's January 28, 1998, response concurred with the Corps' determination that the proposed project would not likely adversely affect the bald eagle (*Haliaeetus leucocephalus*), northern spotted owl *(Strix occidentalis caurina*), marbled murrelet (*Brachyramphus marmoratus marmoratus*), gray wolf (*Canis lupus*) and grizzly bear (*Ursus arctos*).

The Service's concurrence was based upon: (1) the expected implementation of the conservation measures described in the BA; (2) the Corps' statement that phase 2 of the project (conservation pool raise to elevation 1,177 feet, MSL) will not be implemented until it is demonstrated that this action will not adversely affect the Green River's salmon and steelhead resources; and (3) the retention of all merchantable and large trees within the larger conservation pool unless they can be harvested without adversely impacting the restoration of the anadromous fish runs upstream of the project.

DISCUSSION

The proposed project includes both restoration and mitigation elements to address impacts caused by the original construction of HHDR and from enlarging the conservation pool, respectively. The Service believes very significant elements have been included as part of the project and have the potential to restore anadromous fish runs upstream of HHDR, while reducing the unavoidable impacts to acceptable levels. The success of the restoration and mitigation efforts, however, depends heavily on the satisfactory development and implementation of these measures, especially the application of the adaptive management approach, as well as certain actions that are outside of the scope of this project, e.g., harvest management and/or the ability to use supplementation techniques. The following fishery resource discussion pertains to phase 1 of the project. The phase 2 fishery impacts have not been addressed in detail because the gross assumptions that would be required would only lead to highly arguable conclusions of little value at this time.

FISHERY RESOURCES

Biological, physical, and hydrologic studies conducted by the Service, WDFW, Tribe, Corps, Tacoma and others provide a good basis for understanding how HHDR affects both the upstream and downstream fishery resources and the physical and operational improvements that are needed to restore anadromous fish populations. Early work by Seiler and Neuhauser (1985) confirmed that juvenile salmonids passing through HHD suffered high mortality. To address the impacts of raising the conservation pool and the potential for restoring upper basin anadromous fish runs, the following studies or analyses were conducted: (1) the vertical and horizontal distribution of fish in the vicinity of the existing outlet (Dilley, 1994); (2) the travel time of chinook and coho salmon and steelhead smolts emigrating through Howard Hanson Reservoir (Aitkin, et al., 1996a; Warner, 1996); (3) the factors affecting juvenile salmonid travel time through the reservoir (Aitkin, et al., 1996a); (4) the timing and survival of juvenile fish passing through the Howard Hanson Dam (Dilley and Wunderlich, 1992, 1993); (5) the adult return rate of fish planted above and below HHD (Aitkin, 1996b, 1997b); and (6) the effect of raising the conservation pool on tributary habitat (Wunderlich and Toal, 1992). Other studies address lower river flow and habitat issues.

Fish Passage

The proposed fish passage facility contains state of the art features that are intended to optimize fish survival through HHD. The Service concurs that optimizing passage survival is necessary to improve the prospects for restoring naturally sustaining populations of anadromous fish. The Service continues to have a strong interest in restoration of anadromous fish runs above HHDR. The upper basin anadromous fish stocks will be subjected to the mortality associated with passage through both Howard Hanson Dam and Reservoir as well as the hazards faced by the lower river fish stocks. Although better spawning and rearing habitat in the upper watershed and the potential benefit of rearing within the reservoir may compensate for some of the passage losses, the upper basin stocks are likely to be the "weak stocks" of the Green River. Consequently, the rebuilding and continued protection of the upper river's weak stocks would likely require a more restrictive harvest management approach for the Green River or some reliance on hatchery supplementation which would require the lowering of the goal to restore self-sustaining runs. The need to maximize passage survival through the dam justifies the selection of this fish passage alternative over the lower cost options that provide less protection. The Service believes the proposed fish passage alternative is consistent with the objective of optimizing fish survival past the dam. We expect further refinements in project design will occur during the advanced engineering and design phase.

Smolt passage through Howard Hanson Reservoir remains one of the main uncertainties, especially in regard to juvenile chinook salmon delay and survival. The absence of a surface outlet and evaluation facility at HHD greatly limited the study design options for evaluating reservoir passage issues, and likely precluded the ability to obtain conclusive results. Still, the Howard Hanson study data and subsequent analysis suggest smolt passage through the reservoir is more heavily influenced by reservoir refill rates and flow volume, and less by reservoir volume or size (Aitken et al. 1996a, Goetz 1997). The proposal to start reservoir refill earlier and reduce the amount of water that would be stored during the primary outmigration period (April through May) should benefit smolts passing through the reservoir. The Service is also encouraged by the fact that Howard Hanson Reservoir is relatively small and that all of the flow will pass through the entrance to the passage facility with the exception of flood releases.

The survival rate of chinook salmon smolts, and to a lesser degree coho salmon and steelhead, as they pass through the reservoir, is unknown. The Corps in its analysis has assumed a reservoir survival rate of about 65 percent, 85 percent, and 90 percent, for chinook salmon, coho salmon, and steelhead, respectively. The actual survival rate will depend on such factors as: (1) the quality of the rearing habitat, including the availability of prey; (2) the abundance of predators; and (3) the amount of time needed to traverse the reservoir. These factors cannot be accurately quantified at this time. Optimistically, the actual survival rates could exceed the estimates used in the Corps' analysis as a result of the proposed mitigation and habitat restoration measures, including: (1) a state of the art fish passage facility; (2) habitat improvements upstream, within the reservoir zone, and downstream of HHDR; (3) predator control, as needed; (4) water temperature improvements by blending the outflow releases; and (5) the reconnection of side channels.

Even though there are outstanding questions that cannot be answered until Phase 1 evaluation, the Service believes the major improvement in fish passage survival at HHD will offset the reservoir passage mortality that could result from enlarging the reservoir in phase 1.

Fish Production Estimates

The Corps has stated that the fish production estimates are primarily intended to provide the basis for comparing the project alternatives, and to a lesser degree a general sense of the upper basin's fish production potential. Given this understanding, the Service is comfortable with the Corps' approach for analyzing the effect of the AWSP. The Corps' use of a variety of accepted methodologies (described in detail in Appendix F) for estimating potential fish production and the presentation of estimates from other studies, provided a range of estimates for juvenile and adult salmonid fish production. From these estimates, the Corps took what it considered to be the best estimate for each of chinook salmon, coho salmon and steelhead for use in the evaluation of the project alternatives. While it can be argued that the model parameters and assumptions (smolts per square meter, spawners per mile, etc.) are not precise enough, we doubt that further refinement of the models would result in different overall conclusions, i.e., the selection of the preferred fish passage alternative, and the conclusion that the Green River fishery resource would benefit from the AWSP.

Project Operation and Adaptive Management

The existing project has operational, physical, and biological constraints (e.g., June 1 refill deadline, reservoir storage solely for maintaining minimum instream flows, lack of fish passage facilities, competing protective measures for upper and lower basin fish stocks, etc.) that continue to limit the Corps' ability to adequately protect the fishery resources. The AWSP has the potential to eliminate or reduce many of these constraints and provide the flexibility needed to operate the project in a manner more favorable to fish.

An important element of the AWSP is the proposed adaptive management approach for operating the project. This approach has the potential to provide significant fishery resource protection and restoration, based on our review of CH2MHill's modeling runs, and with the assumption that parties making the fish related operations decisions have enough confidence in the historical and current data to act and to make the correct decisions. The model, through an iterative process, can show how to maximize specified desired conditions, e.g., rearing habitat in the spring, while still storing sufficient water to maintain minimum instream flows later in the year. It is unlikely that the level of benefits achieved by the model runs can be attained under real life conditions because the resource agencies and the Tribe would make more conservative decisions to reduce of the risk to the resource.

Still, the model results suggest that significant improvements in maintaining higher habitat levels can be achieved even with a conservative adaptive management approach when compared to the existing mode of operation.

While we are encouraged by the inclusion of the adaptive management approach as a project element, we note that the details are still under development and that commitments on its specific use are still needed. We believe the use of an adaptive management approach for operation of the AWSP will provide significant resource benefits, if it includes the scope and level of flexibility (e.g., baseflow targets, "dampened dam", discretionary use of water for resource protection, 24-hour capability on flow adjustments, etc.) that were presented by the project sponsors during the fall of 1997 project meetings.

Phased Approach

The Service supports the phased approach to project implementation because it defers the decision on whether to proceed with phase 2 until after the review of both the phase 1 monitoring results and the effectiveness of the adaptive management approach.

The fish passage facility (phase 1) will allow the collection of project specific information on the effect of increasing the reservoir size on juvenile passage delay and survival, as well as refill options to reduce the impact. Phase 1 studies are also expected to focus on the effect of additional water withdrawals on side channels usage, steelhead spawning and incubation, and the survival of both salmon and steelhead smolts. In addition, the resource agencies, Tribe and project sponsors will be able to see just how well the adaptive management approach to reservoir refill and release works under real life conditions. An even greater reliance on adaptive management is likely in phase 2 because of the additional storage of 12,400 acre-feet and withdrawal of 22,440 acre-feet from the river.

Habitat Mitigation/Restoration

We are satisfied with the conceptual approach the project sponsors have taken with regard to habitat mitigation and restoration, but note that plans are still under development and are not yet ready for a detailed review. The Service, other resource agencies and the Tribe have not yet participated in the detailed review of the proposed habitat improvement elements. Consequently, it is premature for the Service to provide detailed comments on the specific habitat improvement proposals. We believe the proposed project is likely to contain sufficient mitigation to offset the impacts caused by enlarging the size of the conservation pool, based on the Corps' proposed conceptual approach .

The project sponsors have also identified a number of habitat restoration options (gravel augmentation, side channel re-connection, and riparian/channel improvements) to partially offset the impacts caused by the construction of the existing project. The annual placement of 3,900 cubic yards of gravel would restore and maintain about 400,000 square feet of degraded spawning habitat largely caused by the dam's blockage of gravel from upstream sources. The reconnection of a side channel near Tacoma's Diversion Dam and the implementation of riparian and channel improvements would partially offset habitat losses that occurred by the filling of the original reservoir. The Service supports the implementation of all the restoration options.

Monitoring/Evaluation

The project sponsors have committed to the funding of a fifteen year monitoring and evaluation effort with the focus being directed at the issues and needs associated with phase one. About five million dollars has been budgeted for monitoring and evaluation. The monitoring of project facilities and habitat improvements for their serviceability would continue beyond the fifteen year period under the Corps' operations and maintenance authority. The identification of specific monitoring needs for phase two have been deferred to allow the review of the phase one monitoring results. It has been acknowledged by the project sponsors that additional monitoring and evaluation may be needed to address phase two issues.

The monitoring and evaluation plan is scheduled for development during the Corps' PED phase during 1999 and 2000. While the details of the plan will not be developed until that time, the Service is comfortable (from a planning perspective) with the level of effort and the scope of the issues that have been proposed in the Corps' Feasibility Report and EIS. We expect the proposed monitoring and evaluation plan to address the following issues: (1) juvenile outmigration survival (lower river, reservoir); (2) survival through the fish passage facility; (3) side channel accessibility; (4) habitat improvement measures; (5) maximum refill rates; (6) base flow targets; (7) flow augmentation to protect steelhead spawning and incubation; (8) predation on juvenile salmonids; (9) artificial freshets; and water quality.

WILDLIFE AND BOTANICAL RESOURCES

The Corps' analysis using the HEP results is acceptable to the Service and we support their conclusions. The HEP established pre and post project AAHUs for the four target species. The compensation goal for these species is to offset the AAHUs lost due to the project with a gain of an equal number AAHUs.

The quantification of AAHUs and the compensation for loss depends on a major assumption, i.e., the mitigation or management techniques used to accomplish the changes in habitat are successful at the anticipated level. Depending on the techniques and available evaluation data, this assumption may not be realized. This is especially true in techniques that are experimental in nature and do not have a body of empirical data to support the assumption.

The elk mitigation plan as proposed seems to do an adequate job of provide compensatory habitat. We especially support the efforts to improve forage on non-forested areas since we are concerned about the loss of any forested habitat in the upper Green River basin. The techniques to be used have been successful in other areas and should work quite well in the project area.

Late Successional Forest

We support the efforts to recreate and manage for late successional stage forests; however, this is not a proven technique. We believe that these techniques will provide at least some of the desired characteristics, but due to the length of time needed for many of the late successional characteristics to develop, results are unsure. Intensive monitoring will be needed over several decades to see if the assumptions about the results are true.

The Tacoma Land Management Plan (TLMP) (Ryan 1996) is a policy adopted by the city to protect water quality within the watershed. While the intent seems to be for the long term, policies and goals may change over time. Changes or abolition of this plan could drastically impact forage and other habitat values. This discussion assumes that the TLMP will be implemented and will remain in effect for the next 50 years. With the TLMP in place, the mitigation for pileated woodpeckers and red tree voles may be achieved, but may take several decades more than the 50 year life of the project.

Riparian Zone

The riparian zone is the most valuable of the terrestrial habitat types. The juxtaposition of water and land creates a habitat that brings upland and aquatic species together and produces the most diverse plant community of any upland habitat type. This ecotone, or edge, provides a transition that is highly productive and valuable to many diverse animal species. Some animal groups, such as some salamanders and most frogs, use this zone almost exclusively. Other animal groups use it variously for food, shelter, water, breeding, and rearing. Due to the long, narrow aspect of riparian zones, many animals use it as a migration corridor. Riparian zones provide a less variable humidity and temperature regime and promote greater plant diversity. Many riparian zones are also wetlands and provide sediment filtration, water purification, and flood control.

The value of this relatively small portion of the landscape cannot be overstated. A loss of riparian zone habitat reduces available resources not just in the small acreage it occupies, but also to adjacent habitats in either the upland or aquatic habitat component.

Snags

Snags are a critical element in forested habitats. Snags, dead tops, or dead limbs on larger trees provide the initial substrate for woodpeckers to feed upon and excavate holes for nesting. In western Washington, at least 100 species of wildlife use snags for part of their life cycle. When abandoned by woodpeckers, excavated holes are subsequently used by a variety of animal species, known as secondary cavity nesters, for nesting, rearing and cover. More than 50 species (39 birds and 14 mammals) are cavity dependent (Neitro *et al.*1985). Birds and mammals that use these abandoned woodpecker holes provide an important component of the forested ecosystem.

Pileated woodpeckers are the largest woodpeckers in the Pacific Northwest and require snags greater than 21" in diameter. There is some evidence that they prefer snags with a minimum diameter of 25" (See Table 12). To assure an adequate supply of large snags into the future, forest lands need to be managed on a long term rotation to produce trees of this size.

Other primary excavators, including red-breasted nuthatches, can use much smaller snags. The preferred sizes shown in Table 12 have been derived from several studies in old growth and mature forests where available snag sizes are much larger. In areas such as the proposed project area, smaller sized snags are frequently used, at least by the smaller species, for foraging and sometimes even nesting. Snags of marginal size are important components of second growth forest as foraging or nesting habitat, or as coarse woody debris when they fall to the forest floor.

Table 12. Sizes, Density and Utilization of Snags and Cavity Excavators **(adapted from Neitro, *et al.*1985)**

Woodpecker species	Preferred snag size (min. diameter)	Max Density (D)[1] (pairs/100 ac)		No. cavities excavated/pair/ year (C)	Snags Used (X)	No. snags needed/100 acres (S)		Snags needed/14 acres project area	
		Brush[2]	Forest			Brush	Forest	Brush	Forest[4]
Downy Woodpecker	≥11"		2	2	4	0	16	0	2.24
Red-breasted Sapsucker	≥15"	3	11.3	1	4	12	45.2	1.68	6.328
Hairy Woodpecker	≥15"	11	16	3	4	132	192	18.48	26.88
Northern Flicker	≥17"	12	12	1	4	48	48	6.72	6.72
Red-breasted Nuthatch[3]	≥17"					0	152		21.3
Pileated woodpecker	≥25"		.5	3	4		6	0	0.84

[1]Formula calculation (D) x(C) x(X) = S
[2]Brush = Shrub/open sapling/pole seral stage
[3]Red-breasted nuthatch density and snags used/year not clearly defined.
[4]Assumes that as the stand grows older it will reach the forest seral stage in the future.

Conifer snags have a long useful life because they are much slower to rot. Cline, *et al.*(1980) set up a rating system for snags based on deterioration and condition. Stage 5, which was a very soft and deteriorated snag, could be older than 125 years for snags greater than 18" diameter at breast height (DBH). Larger snags tended to last longer and provide habitat for a longer period of time. Snags less than 12" DBH tended to break at or below the ground surface. Western red cedar and Douglas fir were the most persistent of all conifers. Because conifers grow to a much larger size, they can provide much larger snags that are useable by a wider variety of species. Snags from deciduous trees are more short-lived but are heavily used by both primary and secondary excavators. Rot is faster in deciduous trees and makes them available for excavators much quicker.

Data for the value of snags and standing trees in the inundation zone is not prolific but there are several studies that show a significant use of dead trees surrounded by water. Burns and Dahlgren (1983) indicated significant use by woodpeckers and secondary cavity nesters during summer. Woodpecker use was the same in the surrounding bottomland timber and the flooded areas but secondary cavity nesters showed higher use in the inundated trees. The difference in species diversity seemed to be related primarily to the lack of foliage. Four open-nesting bird species used the trees for perching and nesting. Foraging and perching were observed for several other bird species which nested in the adjacent uplands. Hair *et al.* (1978) showed a similar use of dead trees in beaver ponds. Standing dead trees suitable for feeding and nesting were probably the major factor in the over 200 percent increase in woodpecker density in the beaver pond sites. Secondary cavity nesters also used this habitat during the nesting season.

Cowardin (1969) found significant waterfowl use of dead trees and floating logs. Most of the use was loafing and perching, although there were broods produced in the flooded timber. His study area was flooded in the early 1940s. A significant number of snags were still remaining in 1969 during the Cowardin study. At present there are still 10 to 15 snags remaining. Longevity of these hardwood snags ranged up to 50 years. Although these are in very poor shape, there is an active bald eagle nest in one. There were enough snags standing as of the mid-1980s to support a great blue heron rookery (Gingrich per. com 1997). Ospreys have nested in the snags during the past 50 years.

CONCLUSIONS

The proposed AWSP offers the most feasible opportunity for restoring chinook and coho salmon and steelhead runs to their former habitat upstream of HHDR by retrofitting HHDR with a state-of-the-art fish passage facility, and by adopting an adaptive management approach to project operation. The Service believes the adverse impacts of phase 1 of the proposed project can be reduced to acceptable levels if appropriate mitigation is included. It is premature to assess the impacts of phase 2 because of the importance of the phase 1 monitoring results in determining whether larger storage volumes or greater water withdrawals would result in unacceptable and unmitigatible impacts. The Service believes a phased project is the appropriate approach for addressing these critical uncertainties.

RECOMMENDATIONS

The Service believes the phase 1 impacts of the proposed AWSP can be reduced to acceptable levels if the fish and wildlife mitigation and restoration measures that have been identified in the Feasibility Report and EIS are implemented and the following recommendations are incorporated into the AWSP. We are not providing our phase 2 fishery resource recommendations at this time because their development should be based on the phase 1 monitoring and evaluation results.

FISHERY RESOURCES

1. The fish passage facility should be designed to achieve maximum fish survival past HHD. The Service supports the Corps' proposed option, which includes a new intake tower, floating collection facility, modular incline screen, fish lock and bypass system. Additional refinements should be pursued during the advanced engineering and design phase to further enhance passage survival.

2. Impacts to riparian and stream habitats from enlarging the conservation pool need to be fully mitigated. The Service supports the Corps' mitigation approach, but we cannot specifically address the adequacy of the selected elements at this time because the details are still being developed. The Service requests the opportunity to participate in the development of the mitigation elements during the Corps' Plans and Specifications Phase.

3. All of the identified restoration elements should be implemented. The construction of HHDR adversely affected the natural transport of sediments necessary to replenish spawning habitat, inundated riparian and stream habitats, and eliminated most of the high flow events needed to create side channels. All of the restoration measures are needed to partially offset these impacts. The Service requests the opportunity to participate in the design refinement of the restoration elements during the Corps' Plans and Specifications Phase.

4. An adaptative management approach to project operation should be adopted and used to provide maximum flexibility to protect and enhance the fishery resources. At the very least, it should specifically address: (1) base flow targets; (2) adequate flow levels to protect steelhead spawning and incubation; (3) refill rates and storage volumes that maximize survival through the reservoir; (4) flows to maintain the optimal use of side channel habitat; and (5) the creation of artificial freshets, if needed.

5. The storage of up to 5,000 acre-feet in non-drought years should be implemented at the beginning of phase 1, as part of the adaptive management approach. The resource agencies and Tribe, in consultation with the Corps and Tacoma, should have the joint responsibility for making the decision on how much of this water to store in any given year (including the option of not storing additional water) after considering the current conditions.

6. The "dampened dam" approach, as describe in Appendix F of the Corps' Feasibility Report and EIS, should be included as a project feature.

7. Reservoir refill should begin by February 15 and target an end of February storage volume of 5,000 acre-feet. The Corps should conduct the appropriate analysis to resolve the flood control concern of King County, if necessary. The February storage of water would reduce the amount that would need to be taken during the period, March through May, when fishery impacts would likely be greater.

8. Initially, the Corps' proposed maximum refill rates (400 cfs in March, 300 cfs in April, and 200 cfs in May) should be used and evaluated.

9. The storage volume of 25,400 acre-feet should be further evaluated to determine if this quantity is necessary to provide the project authorized 98% reliability for maintaining a minimum instream flow of 110 cfs.

10. Continuous staff coverage at HHDR (i.e., personnel available on a 24 hour per day, 7 day per week basis) should be provided, as needed, during project refill and other critical periods, e.g., steelhead spawning, to allow more timely adjustments in project outflow to provide better protection of the fishery resources. More frequent coordination with the resource agencies and Tribe will also be necessary.

11. The Corps should continue to develop its hydrologic data base and refine its ability to accurately forecast runoff. The reliability of the snowpack surveys for use in predicting runoff should be improved.

12. All large trees within the enlarged conservation pool between elevation 1,141 and 1,177 feet MSL should be retained as fish habitat to improve the prospects for restoring self-sustaining runs of anadromous fish above HHDR.

13. Measures to protect Tacoma's water quality should not come at the expense of the fishery resources. If it is necessary to flush turbid water from storage or to delay refill to pass turbid water, the lost or precluded storage should be deducted from Tacoma's storage account, unless replacement can be accomplished without adversely affecting the fishery resources.

14. The trap and haul of sufficient adult steelhead and salmon to achieve the natural production objectives for the upper watershed should not be precluded by Tacoma's water quality concerns.

15. The Service, other resource agencies, and the Tribe should be given the opportunity to participate in the development of the monitoring and evaluation plan during the Corps' PED phase.

TACOMA LAND MANAGEMENT PLAN (TLMP)

1. The TLMP is the major component upon which most of the mitigation planning has been based. It is the recommendation of the Service that this plan be adopted as part of the mitigation package and used to further refine specific components of the plan.

2. The TLMP should be modified to reflect current recommendations for snag densities and coarse woody debris.

ELK AND OTHER SPECIES USING PASTURE AND FORAGE

1. The quality and quantity of elk forage should be increased by:

   a. Expanding existing meadows by reversing conifer encroachment.
   b. Creating new meadows within selected forest stands next to existing openings.
   c. Increasing forage value within power line right of ways (ROW).
   d. Increasing forage value in existing meadows.

   Techniques to be used are described in Raedeke (1996) and in previous Planning Aid Letters from the Service. The Service has provided suggested seed and fertilizer mixes previously (Bodurtha 1995).

2. Within the ROW, evergreen trees and shrubs should be planted to break up sight distances and screen the pasture areas from the roads. Tree species that should be considered include Pacific yew (*Taxus brevifolia*), Lodgepole pine (*Pinus contorta*), and Western white pine (*Pinus monticola*) since they are either naturally short or can be easily maintained at shorter heights. Several *Vaccinium* species should be considered since although they are deciduous, the leaves tend to persistent through much of the winter. In addition, yew and *Vaccinium* are preferred browse species and would provide additional forage value.

3. Sites should be selected from the list provided in Raedeke (1996) to provide the widest range of opportunity for forage production and diversity. The initial sites should be monitored closely until the initial assumptions for increased forage are realized. Although the techniques have been shown to be successful in other areas, they have yet to be proven for the specific site conditions in the project area. The loss of substantial elk habitat dictates that we make a concerted effort to at least replace this lost habitat.

4. A small area of each meadow should be used to test the techniques to determine which one would provide the best results in terms of enhancing productivity and increasing forage. For example, applications of various fertilizers on small tests plots could help indicate which fertilizer would be most appropriate.

5. To attract elk to the improved or created meadow sites, salt or mineral blocks could be placed in these areas in advance of the pool raise. Mineral and protein supplements have been used successfully to draw livestock to upland sites and to re-distribute use over a larger area.

6. It would appear from the proposed filling schedule that a substantial part of the inundation zone would be above the water line during the growing season in late August and September. We recommend that a fall planting of cereal rye, winter wheat, and perennial rye be tried on any mudflats that develop as a result of inundation. Cattle growers have used these grasses to provide winter food sources for grazing. White-tailed deer have been observed in Kansas using this food source along with the cattle. Cereal rye and winter wheat has been planted for and used by elk in Southwest Oregon (Gene Stagner personal observation). These cereal grains germinate quickly and provide rapid cover and forage throughout the winter. If the initial tests of these cereal grains show success in providing usable winter forage the Service recommends that this should become part of the annual management plan for forage.

7. Use a wide variety of plant species (black cottonwood, rushes, and other species of willows and sedges) to revegetate the drawdown zone. This will help increase the habitat diversity and subsequent use by fish and wildlife.

8. Optimal thermal cover is significantly lacking in the project area. The techniques used to improve pileated woodpecker habitat will also help re-establish optimal thermal cover. Under planting with shade tolerant shrubs and conifers will allow a more rapid development of winter forage base and better snow interception.

PILEATED WOODPECKERS, OTHER PRIMARY EXCAVATORS AND RED-BACKED VOLES

1. The development of late-successional characteristics should be accelerated using the following techniques:
   a. Provide at least .5 snags per acre $\geq$ 20" dbh for primary cavity nesters.
   b. Provide at least 11 snags per acre from 6" to 20" dbh for smaller woodpeckers and secondary cavity nesters.
   c. Provide raptor perch trees and snags at the edge of the reservoir. The trees and snags within the new conservation pool should be left standing because of their value to wildlife. Trees and snags will provide important perching and nesting habitat for birds, and hiding cover for fish when the reservoir is full.
   d. Thin even age class stands to stimulate mid-story and understory species development.
   e. Maintain the dominant trees in all aged stands and cut subdominant conifer and deciduous. During thinning it is important to retain some of the mid-level canopy if present.
   f. Leave felled trees on the ground to increase the coarse woody debris (CWD) component of the forest floor. This component of the forest ecosystem is especially important for the red-back vole, one of the target species. Many other forest species use a wide variety of CWD sizes.

g. Under plant with shade tolerant shrubs and conifers to allow a more rapid development of a multi-level canopy.

2. Manage the land base to develop natural snags as much as possible. In areas lacking in snags, create snags by topping live trees or installing artificial snags. Provide a wide variety of sizes and decay classes of snags. This will need to be a long-term effort due to the relatively young stands involved. Preferred trees species are Douglas fir and Western red cedar.

3. Our recommended topping technique is blasting above at least one live lower branch. The jagged top left by blasting seems to provide a more rapid snag development than does topping with a chainsaw.

4. In areas devoid of snags or cavities, it may be necessary for a short time period to provide nest boxes or constructed cavities. Since primary excavators rarely use nest boxes these should be provided in sizes and appropriate habitat to accommodate secondary cavity nesters such as wood ducks and bluebirds.

5. Artificial snags should be randomly erected within the natural and conservation zones to help mitigate the loss of pileated woodpecker AAHUs.

WOOD DUCKS AND OTHER WETLAND DEPENDENT SPECIES

1. Sub-impoundments should be created along the perimeter of the upper reservoir and other appropriate locations to function as shallow open water habitat during drawdown. This would help reduce the loss of riparian zone and wetland habitats and provide stable habitat areas for wood ducks, amphibians and other wetland dependent species. The close proximity between open water and forest habitats would result in greater diversity. The Service believes the creation of sub-impoundments would provide significant benefits to fish and wildlife, and therefore, should be included. This will especially benefit amphibians that breed in slack or slow moving water and utilize submerged vegetation for food and spawning substrate.

2. The creation of a sub-impoundment behind the old railroad grade should be included as a project element because of the significant wildlife benefits that would result from its implementation. An outlet structure that is capable of safely passing fish would be a necessary component of this restoration element.

3. Habitat within the upper reservoir subimpoundments should be improved (install wood duck nest boxes, place large woody debris, plant emergent vegetation and willow cuttings).

MONITORING AND EVALUATION

1. The Service recommends the development of a management plan specific to the project mitigation lands. This plan should be approved by appropriate agency representatives and include annual management evaluations and the development of an annual standard operating procedure (SOP) that would detail the specific management techniques to be applied during the next year. An annual report should be prepared that would include an outline of the activities on the sites, any evaluation and monitoring results, and recommendations for future work.

   The TLMP should be used as a basis to develop this plan since most of the goals and objectives for natural and conservation zone lands meld with the goals and objectives for mitigation of this project. The advantage in a specific management plan would be that there would be a standing committee of agency representatives to help evaluate proposals and results, and suggest changes in management to better fit new information or changes in objectives. A signed agreement would give some long term assurance that the goals and objectives for the project lands would not be arbitrarily changed due to changes in Tacoma's management philosophy.

2. A detailed monitoring plan should be developed after the decision has been made on specific restoration elements. For the first 5 years, annual reports should be prepared that contain the monitoring results of the preceding year so that refinements to the restoration program can be made, as needed. From year 6 to year 20 reports should be prepared every 5 years and every 10 years from year 20 to year 50.

   Monitoring is necessary to determine the effectiveness of the restoration efforts, whether the restoration plan needs to be modified, or if corrective measures need to be taken. The Service should participate in the review of the monitoring results and annual report.

3. A contingency plan and process are needed to guide management changes if the present techniques are not creating the desired conditions. An adaptive management approach should be used so that the desired future conditions for all species are met.

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APPENDIX A

Summary table of all aquatic restoration and mitigation management measures for the Howard Hanson Dam Ecosystem Restoration and Additional Water Storage Feasibility Study
(Source: Corps of Engineers)

Project Package Name	Activity Name	Project Number	Mitigation/ Restoration	Location
Howard Hanson Dam Fish Passage	Dam Fish Passage Alternative 4	FP-04	M/R	Howard Hanson Dam, Right Bank, Intake Tower, 1070-1177 ft Elevation
Headwaters Green River Habitat Mitigation	Mainstem and Sunday Creek Habitat Restoration	MS-04	M	Headwaters Mainstem below Sunday Creek Confluence
Headwaters Green River Habitat Mitigation	Tacoma Wildlands Set-asides in Conservation and Natural Forest Zones	MS-08, TR-09	M	Headwaters Floodplain, RM 71.3-80.1, Gale Creek 1240-1280 ft el., N. Fork 1240-1320 ft el.
Howard Hanson Reservoir Mitigation Zone	Mainstem and North Fork Channel Maintenance	MS-02, TR-04	M	Headwaters and North Fork in New Inundation, 1146-1177 ft Elevation
Howard Hanson Reservoir Mitigation Zone	Tributary Stream Channel Maintenance	TR-05	M	Tributaries to Reservoir in New Inundation, 1146-1177 ft Elevation
Page Mill Pond Mitigation	Page Mill Pond and Page Creek Maintenance	VF-05	M	North Fork Green Floodplain, Left Bank, 1147-1185 ft Elevation
Bear Creek Channel Improvement	Lower Bear Creek Stream Restoration	TR-01	M	Lower Bear Creek, Below HHD at RM 64
Headwaters Green River Habitat Mitigation	Headwaters Culvert Replacement	TR-10	M	Three tributaries in Headwaters Watershed, two small tribs and one large tributary
Middle Green River Side Channel Mitigation	Loans Levee Removal and Burns Creek Reconnection	LVF-03	M	Middle Green River Floodplain, Right Bank, RM 37.9-38.1
Middle Green River Side Channel Mitigation	Metzler and O-grady Connector Side Channel Improvement	LVF-04	M	Middle Green River Floodplain, Left and Right, RM 39-40.2
Middle Green River Side Channel Mitigation	Flaming Geyser North: Cutoff Channel Reconnection	LVF-06	M	Middle Green River Floodplain, Right Bank, RM 44.3
Upper Green River Side Channel Mitigation	Brunner Side-Channel Restoration	VF-03	M	Upper Green River Floodplain, Right Bank, RM 58
Howard Hanson Reservoir Restoration Zone	Mainstem, North Fork and Tributary Restoration	MS-03, TR-06, TR-07	R	Headwaters, North Fork, Reservoir Tributaries, 1177-1240 ft Elevation
Upper Green River Side Channel Restoration	Signani Side-channel Reconnection and Restoration	VF-04	R	Upper Green River Floodplain, Left Bank, RM 58.6-59.6.
Mainstem Green River Gravel Nourishment	Middle Green River Gravel Bar Nourishment	LMS-01, LMS-02, LMS-03, LMS-04	R	Middle Green Mainstem, 4 Alternate Locations, RM 40-45
Truck and Haul of Large Woody Debris	Collection and Transport or Reservoir Woody Debris	MS-09	R	Upper Green River, Left Bank, RM 59-60.3

APPENDIX B

Location and Description of Potential Terrestrial Mitigation Sites (Source: Corps of Engineers)				
Site #	Site Description	Treatment Type	Treated Area	Phase
1	BPA right-of-way; grassland and young deciduous forest maintained as shrubs	pasture.	18 acres	1
2	BPA right-of-way; grassland and young deciduous forest maintained as shrubs	pasture	45 acres	1
3	BPA right-of-way; grassland and young deciduous forest maintained as shrubs	pasture	15 acres	2
4	BPA right-of-way; grassland and young deciduous forest maintained as shrubs	pasture	14 acres	2
5	Baldi Field: 50 %of site is grassland, 30 % is mixed forest and 20 % is mature conifer forest.	pasture.	18 acres	1
6	Puget Sound Energy (PSE) ROW, and adjacent Conservation lands. 80% of site is young deciduous forest; 15 % mature deciduous forest and 5 % mixed forest.	pasture.	11 acres	2
7	PSE ROW, and adjacent Conservation lands. 60% of site is young deciduous forest; 40% is mature deciduous forest.	pasture	11 acres	1
8	PSE ROW, and adjacent Conservation lands. young deciduous forest and grassland	pasture	14 acres	1
9	Deciduous forest within the Conservation Zone.	LS forest	10 acres	1
10	Mature mixed forest within the Natural Zone.	LS forest	10 acres	1
11	Mature deciduous and mixed forest stands within the Natural Zone.	plant sedge LS forest	8 acres 2 acres	2
12	90 % young deciduous forest and 10 % young conifer forest in the Conservation and Natural Zones.	LS forest	10 acres	1
13	65 % mixed forest and 35 % deciduous forest within the Natural Zone.	LS forest	10 acres	1
14	60 % mature conifer forest and 40 % mixed forest in the Conservation Zone; small portion is within BPA ROW.	pasture. LS forest	5 acres 15 acres	2 2
15	95 % mixed forest and 5 % mature conifer forest located in the Conservation Zone.	LS forest	15 acres	1
16	100 % deciduous forest in the Natural Zone.	plant sedge	10 acres	1
17	Koss Field: 80 % mature deciduous forest and 20 % grassland.	wetland pasture. impoundment	10 acres 9 acres 1 acre	2 2
18	85 percent mature deciduous forest, 10 percent mixed forest and 5 percent mature conifer forest on TPU Conservation Zone.	LS forest	5 acres	1
19	Mature conifer and mixed forest habitat in Conservation Zone	LS forest	15 acres	1
20	Mature deciduous forest habitat and emergent wetland in Conservation Zone	LS forest	9 acres	1
22	Mature alder-dominated deciduous forest adjacent to the 1147' pool in Natural Zone.	impoundment plant sedge. plant willows & Oregon ash	3 acres 5 acres 3 acres	1 2
23	70 percent /mixed forest and 30 percent mature conifer forest adjacent to the 1147' pool in Natural Zone.	plant sedge. plant willows & Oregon ash	20 acres 1 acre 6 acres	1 2
24	18 acres of grassland / emergent wetland (upper edge of McDonald field) and 12 acres mature mixed forest and forested wetland within the Natural Zone west of McDonald Creek.	wetland plant sedge plant shrubs plant sedge impoundment	2 acres 29 acres 4 acres 2 acre 6 acre	1 2
25	Grassland between McDonald Creek and Gale Creek.	plant sedge plant sedge	5 acres 2 acres	1 2
26	Forest stands located outside of the identified sites managed for LSF. Primarily between Cottonwood Cr. and Gale Cr., or upstream of the reservoir	LS forest	50 acres 100acre	1 2
27	Mixed forest and forested wetland north of the old railroad berm in the upper end of the reservoir east of Gale Creek.	impoundment	5 acres	1

APPENDIX C

Response to the Muckleshoot Indian Tribe's May 6, 1998 letter

The following discussion responds to a number of the comments the Service received from the Muckleshoot Indian Tribe on our draft Fish and Wildlife Coordination Act report. Other comments were addressed in the main body of the report. The Service did not receive written comments on our draft report from the state or federal resource agencies.

1. The Service concurs that it is impossible to reliably predict the "with project" outmigration survival rates, or the net benefit for chinook salmon and other stocks of fish that would be produced in the upper basin, including the effect of enlarging the conservation pool under phase one. We are confident, however, that the survival rates through Howard Hanson Reservoir and Dam will be a significant improvement over the very low survival rates that now occur through the existing 48" diameter outlet. We also believe that lower Green River flows under phase one will be greater during the primary outmigration period, April through May, as a result of starting refill earlier. Consequently, we expect outmigration survival to benefit over the "without project" condition.

We, too, have significant concerns over the additional water withdrawals and increased departure from the natural flow regime that would likely occur in phase two. Because of the uncertainty of these factors on the fishery resources and the inability to test them in advance, we have deferred our assessment and position on phase two of the project until the monitoring/evaluation results from phase one and other relevant information are available for review. Please note that our draft CAR assessment of the fishery impacts related to the AWSP was limited to phase one.

2. The Service supports the AWSP's goal of restoring self-sustaining populations of anadromous fish to the Green River's upper basin. We have never suggested that the Tribe assume a disproportionate share of the burden for restoration. We note, however, that harvest rates (ocean, Puget Sound, and in river, combined) for chinook and coho salmon often exceed 50 percent and 70 percent, respectively. Consequently, we believe achieving the goal of restoring self-sustaining populations will very likely require changes in the current harvest management approach for commercial, recreational and tribal fisheries, unless the survival rate through the Howard Hanson Dam and Reservoir proves to be much higher than predicted. The Service does not oppose supplementation, but we believe all realistic efforts should be taken before lowering the restoration goal and relying on permanent hatchery supplementation to maintain the upper basin's anadromous fish runs. We support the use of temporary supplementation, if needed to initiate the restoration of the upper basin stocks, and if the proposed supplementation techniques are determined by the NMFS to be consistent with their objectives under the Endangered Species Act.

3. We believe it is premature to conclude that the restoration and maintenance of self-sustaining populations cannot be achieved. We have acknowledged in our draft CAR that the restoration of naturally self-sustaining populations of salmon to the upper basin will be difficult or impossible under the current harvest rates, in large part because of the loss or degradation of habitat and the additional mortality that would be sustained in passing through the reservoir. On the other hand, we are also optimistic that habitat restoration will occur over time as a result of the AWSP and other actions, including habitat conservation plans, the Section 1135 Green River Basin Restoration, conservation measures related to the Endangered Species Act, etc.

. We take our trust responsibilities to Indian Tribes seriously, as we do our fish and wildlife responsibilities under other mandates, regulations, and laws. We believe we have met these responsibilities and considered the tribes concerns by deferring our position on phase two, by supporting adaptive management to address project uncertainty, and by emphasizing that changes in harvest management will be necessary to achieve the restoration of self-sustaining populations of anadromous fish above Howard Hanson Dam. As stated earlier, the Service does not oppose supplementation, but considers it premature to drop the goal of restoring naturally self-sustaining populations of salmon and steelhead to the upper basin.

5. Comment noted. See discussion under MIT/TPU Settlement Agreement.

6. An increase in the number of planted fish below HHDR is one possible outcome of terminating fish plants to the upper basin. However, we do not consider it the only option, given the proposed chinook salmon listing by the National Marine Fisheries Service and the State's wild salmonid policy.

7. Comment noted.

8. The failure to meet the escapement goal for chinook salmon in three of ten years during the last decade and the tribe's decision to refrain from fishing in a number of years during the 1980's suggest to the Service that a harvest management problem exists. No apportionment of the responsibility for the shortfall was made in the CAR.

9. The Service does not share the Muckleshoot Tribe's optimism. Based on our recollection of project meetings and statements made by Tacoma and the Corps, we still believe it is very unlikely that the project sponsors would implement all of the elements that the Tribe has identified in the absence of the AWSP.

10. Comment noted.

11. The Green River no longer has a natural flow regime. Water diversions by Tacoma and flood control by the Corps have significantly altered the flow regime. Furthermore, the 25 percent reduction in flow from present conditions would be the result of Tacoma exercising its second supply water right, not the implementation of phase 1 of the AWSP. We accept Tacoma's claim that there are feasible alternatives for storing their second supply water right, if Howard Hanson Reservoir is not available.

Given the fact that the Green River is already an altered and highly controlled system, we support the adaptive management approach to reservoir refill which allows some opportunities for preserving or restoring the shape of the natural hydrograph, while making some flow adjustments to address real time fishery needs. The Service believes that risks of an increased departure from the natural flow regime by Phase 1 of the AWSP is low because the project can be made flow neutral by having Tacoma's second supply water right stored at Tacoma's permitted withdrawal rate, i.e., 100 cfs. At the present time, we see little value in the latter approach.

MUCKLESHOOT INDIAN TRIBE

FISHERIES DEPARTMENT

May 6, 1998

Mr. Gwill Ging
U.S. Fish and Wildlife Service
Western Washington Office
51 0 Desmond Drive S.E., Suite 102
Lacey, Washington 98503

RE: Howard Hanson Additional Water Storage Project (AWSP) Draft Coordination Act Report

Dear Mr. Ging:

Thank you for the opportunity to review the DCAR presenting the USFWS preliminary conclusions on the expected benefits and impacts to fish and wildlife of additional water storage at Howard Hanson Dam (AWSP) and the proposed project mitigation. Due to fieldwork timing, terrestrial concerns, especially elk, will not be addressed in this letter. They will be addressed in our comments on the Draft Environmental Impact Statement

The main project elements are 1) new storage of 20,000 acre-feet raising the total Phase I reservoir volume to approximately 50,000 acre-feet for municipal supply and flow augmentation purposes; and 2) a new state-of-the-art fish passage outlet at HHD. Other elements, not yet fully defined, include an adaptive management approach to reservoir operations, a number of fish and wildlife habitat mitigation projects, and a 15-year monitoring plan.

The Muckleshoot Tribe remains concerned about the impacts of this project on its treaty rights and resources reserved by the Point Elliot and Medicine Creek Treaties as affirmed in U.S. *vs* Washington 384 F. SUPP. 312 (W.D.Wash. 1974). Because of the central role of Green River fish and wildlife resources in the culture, economy and diet of the tribal community, the many environmental uncertainties, and the potential direct and indirect effects of the AWSP on treaty rights, the Tribe does not have a high degree of comfort with this project. We have communicated these concerns as clearly as possible over the course of the interagency technical review process for this project.

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As you know, the AWSP involves hard-to-assess offsets and trade-offs between species and life stages, between benefits and impacts, and between upstream and downstream resources. As an example, while the new dam outlet promises to restore access to more than 100 miles of anadromous habitat, the potential net gain is impossible to predict given the expected, non-quantifiable reduction in outmigration survival for chinook and other species that result from pool enlargement and lower river flows during spring months.

1 The Tribe is concerned that the AWSP will create new habitat limitations especially for chinook and chum. While it is certain that the AWSP will improve the reliability of the Tacoma water supply, we are not certain the new outlet or proposed habitat mitigation will offset the negative effects of increasingly artificial flow regulation, increased withdrawals, and an enlarged pool. Despite the benefits of flow augmentation to specific life stages of certain species, it is not clear that the overall productivity of the ecosystem can be protected under increasing departure from the natural flow regime. This increasing departure from natural flows is at odds with the growing literature on the importance of protecting natural flow regimes to maintain and restore native fish and their ecosystems.

We are concerned that the mitigation burden for AWSP impacts will be shifted from the project sponsors to the Green River terminal area treaty and sport fishery in the form of further harvest reductions. The DCAR repeatedly suggests that harvest restrictions will be required to compensate for the AWSP impacts on chinook in-reservoir and in-river survival and to facilitate chinook restoration to upper watershed habitat. In fact, the DCAR appears to recommend harvest restrictions alone as the preferred way to make the whole AWSP fisheries restoration work. For example on Page 30, the DCAR states

> *"Consequently, the restoration prospect is considered favorable for steelhead, fair for coho salmon, and poor for chinook salmon without a significant change in the harvest management strategy"* and *"The restoration of chinook salmon in the upper basin is considered poor mainly because of potentially high reservoir passage mortality and*
2 > *because of resistance by one or more of the resource managers to lowering the current harvest rate".*

The Tribe does not oppose harvest restrictions and frequently imposes harvest restrictions when necessary to protect escapement. However, the Tribe is not eager to reduce its meager remaining treaty fisheries in order to restore fish runs above HHD without the ability to use supplementation to address habitat limitations arising from TPU water supply development and other factors. To illustrate our concern with regard to AWSP impacts alone, an estimated 28% of Green River fall chinook are harvested outside the terminal area by Canada. Should this fishery be eliminated entirely, which is doubtful, it would still not offset the 35% chinook in-reservoir mortality predicted for the AWSP by the

Corps of Engineers staff or make up for the added in-river mortality expected in the 63-mile long reach below HHD.

3 We request that the CAR include a more realistic assessment of the potential for naturally sustaining, (non-supplemented) upriver and downstream populations of chinook, coho and chum given cumulative losses and habitat impairment. Such an assessment should consider the near-total loss of the Duwamish salt marsh estuary, the impact of Duwamish contaminants on these fishes, the present and planned flow alterations, the additional in-river mortality occurring between the dam and the bulk of chinook spawning 20-30 miles downstream, stray rates of upper watershed fish into the lower watershed, and the poor quality of stream habitat above the dam. These factors indicate that use of careful supplementation will be necessary to re-establish and maintain the upper basin population and provide for lower river fisheries.

4 The Service has a trust responsibility to Indian Tribes to insure that treaty rights are not diminished and are meaningfully protected. A recent manifestation of this trust duty is found in the Secretarial Order of June 5, 1977. Given that the AWSP raises environmental and fisheries management issues of enormous consequence to the Tribe, we ask that evidence of the Service's trust responsibility be more clearly incorporated into the final CAR report. Below are our specific comments on the DCAR.

Page 12: NMFS ESA listing of Puget Sound Chinook Salmon

We agree that it is unknown what measures may be required by NMFS in the event that chinook salmon are listed. One possible outcome that should be mentioned in this section is whether NMFS will see any wisdom in allowing threatened fall chinook into the upper watershed to suffer a 35% mortality rate in the reservoir, when a higher survival rate is guaranteed in the lower river.

5 The CAR should state that the Tribe has requested reasonable assurances from the Corps, Tacoma, NMFS and WDFW to insure that the AWSP and its fish and wildlife mitigation measures will not undermine the 1995 MIT-TPU Settlement Agreement intended to mitigate the impacts of the first and second water supply diversions on treaty fish and wildlife. In the event that these assurances are not provided, the Tribe is aware that its ability to exercise its legitimate treaty rights may be in doubt as a result of this AWSP.

Page 13: Fishery Resources

The DCAR states that overfishing along with habitat loss has caused dramatic declines in naturally spawning anadromous fish in the Green River. The CAR should qualify this statement with regard to overfishing, or offer specific information about the nature, geographic location, and extent of overfishing on individual species, and the relative effect of marine survival trends. For example, since 1990 the average natural chinook escapement to the Green has averaged 1,000 fish more than the escapement goal. Steelhead, which are also managed for natural escapement, average about 700 fish over the goal of 2,000 annually. What evidence is there that overfishing has impacted sea run cutthroat trout, Dolly Varden/bull trout, and/or pink salmon? Recent aggressive chum salmon escapement surveys have placed the run at over 10,000 fish annually, although there is no escapement goal for the basin.

The hatchery production values should state which fish are currently planted in the upper watershed.

Page 11: Related Actions

In the discussion of the HHD Section 1135 Restoration, the DCAR should note the potential conflict between the MIT-TPU Settlement Agreement and the Section 1135 Project involving storage of an extra 5,000 acre-feet surcharge storage for flow supplementation purposes. The Agreement specified support for storage of 5,000 acre-feet during spring drought estimated to occur at a 1 in 5 year frequency, as recognized by May 1 snowpack levels at Stampede Pass and reservoir inflow. A maximum of 2,500 acre feet of surcharge storage can be used for flow augmentation during spring, the Agreement requires that the remainder is used during summer and fall for low flow augmentation. If more than 2,500 acre-feet is used during spring for steelhead incubation or other purposes, Tacoma is not obligated to provide the 250 c.f.s. critical instream flow at the Auburn gage as specified in the Settlement Agreement. The Tribe is disinclined to support annual storage of 5,000 acre-feet in non-drought years but is willing to defer this issue to the interagency adaptive management process pending analysis of potential impacts on chinook outmigration and other needs.

Page 23: Future Without the Project

The analysis should assume that some habitat restoration projects will be implemented particularly in the lower river as evidenced by several King County plans developed independently of the AWSP or as prompted by a County or other response to an ESA listing.

6 In addition the assumption that fish plantings above the reservoir will be discontinued ignores the obvious corollary, that plantings below the project will be increased. This has implications for the survival of these planted fish, and their contribution to lower river fisheries.

7 The statement that emphasis on restoring naturally reproducing populations of salmon and steelhead will lead to greater numbers of fish being able to spawn naturally in the river ignores the fact that chinook and steelhead are presently managed for optimal natural escapement.

Page 30: Future With the Project

The Service assumes that the fish passage improvement will be effective, but it is not known what level of improvement will bear out and for which species. We agree with the DCAR conclusion that fish passage mortality may be significant but is impossible to quantify because it is dependent upon reservoir rearing quality, predator/prey abundance, transportation flows through the reservoir, and other factors. Again, in contrast to the easily-predicted and obvious municipal water supply benefits, the AWSP is a difficult proposal to assess.

A key assumption held by both the Service and by the Tribe is that permanent supplementation will not be precluded by the listing of fall chinook salmon. Should this not be the case, our concerns with the AWSP will be further exacerbated as there will be no way to mitigate for habitat limitations arising from this project, existing water development and other impairments.

It should be acknowledged that the target flows of 900, 750, and 575 for wet, normal, and dry years, while providing some valuable instream protection, do not provide for high survival rates for chinook or chum outmigration, early coho rearing, nor fully provide for other spring flow functions in the lower river.

Page 31-33: Fishery Resources Upstream of HHDR

We note the Service's optimism that the eventual significant improvements in forest management practices and recovery of upper basin habitat will result from the increasing emphasis on habitat restoration and protection. In our experience to date, little protection and restoration has been evident. In this discussion, the CAR should note the poor to fair habitat rating of the upper watershed due to historic and continuing timber harvest activities on private land, and the high road densities averaging 3.6 miles/square mile and reaching 6 miles/square mile in some subbasins (US Forest Service Watershed Analysis for the Upper Green River).

In reference to the potential production estimates by the Corps, the DCAR states

> *"We acknowledge that significant changes in the current harvest management strategies for chinook and coho salmon would be necessary for these escapement levels to be reached".*

Here again, the DCAR suggests that harvest restrictions alone (as opposed to supplementation, or at least a combination of harvest restrictions and hatchery supplementation) are the key to make upper watershed fish recovery work.

8 The DCAR statement that *"the low numbers of harvestable natural chinook and the natural production objective for the Green River has resulted in conflicts between the Tribe and WDFW"* incorrectly suggests that the Tribe does not support the

8 escapement goal nor the concept of equitable harvest restrictions for necessary stock conservation. The Tribe fully supports the spawning escapement goal of 5,800 natural chinook and makes every effort to manage its fishery and to influence WDFW sport harvest decisions to meet this goal. The Tribe voluntarily ceased fishing for chinook for a period of four years in the 1980's for conservation purposes. The escapement goal for Green River naturally spawning chinook has been met 70% of the time over the last decade.

Page 33: Fishery Resources Downstream of HHDR

9 The elements 1 through 6 that offer greater flexibility and improvements in instream flow management are relatively low-cost items and could realistically be achieved without the AWSP.

Page 42-43: Discussion, Fishery Resources

We agree that the success of restoration and mitigation depends on the satisfactory development and implementation of these measures *"especially adaptive management, as well as certain actions outside the scope of the project, e.g. harvest management"*. The phrase "and/or the ability to use supplementation techniques" should be added to this sentence.

10 While we agree there may be some compensatory rearing in the reservoir, we are not convinced that better spawning and rearing habitat exists in the upper watershed than in the lower watershed.

The DCAR suggests the Service has developed a bias in support of harvest restrictions and against the use of supplementation that bleakens and narrows the potential outcome of the AWSP and related actions for legitimate fish harvest opportunity. For example, on Page 42, the DCAR states

> *" the upper basin stocks are likely to be the "weak stocks" of the Green River. Consequently, the rebuilding and continued protection of the upper rivers weak stocks would likely require a more restrictive harvest management approach for the Green River. "*

The phrase "and/or the use of appropriate supplementation techniques" should be added to this sentence. The DCAR should acknowledge that acclimated smolt release programs are being used with success to restore and reintroduce fish stocks elsewhere in the region. This can be an acceptable means to accelerate recovery rates and increase the chances for harvestable fish, particularly in the case of continuing habitat impacts and trade-offs such as those presented by the AWSP.

Page 44: Phased Approach