1 Introduction

The Revised Code of Washington (RCW) directs the Washington Department of Fish and Wildlife (WDFW) to "preserve, protect, perpetuate, and manage" the fish and wildlife species of the state as its paramount responsibility (RCW 77.04.012). Under RCW 77.55, any construction or work that uses, diverts, obstructs, or changes the natural bed or flow of state waters requires a Hydraulic Project Approval (HPA) issued by WDFW. The purpose of the HPA program is to ensure that these activities are completed in a manner that prevents damage to public fish and shellfish resources and their habitats.

Because several fish species in the state are listed as threatened or endangered under the federal Endangered Species Act (ESA), many of the activities requiring an HPA may also require approvals from the National Oceanic and Atmospheric Administration Fisheries Service (known as NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS) (collectively known as the Services). Such approvals can be in the form of an ESA Section 7 Incidental Take Statement or an ESA Section 10 Incidental Take Permit (ITP). As authorized in Section 10, ITPs may be issued for otherwise lawful activities that could result in the "take" of ESA-listed species or their habitats. To "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct (16 United States Code 1532(19)).

WDFW is developing a programmatic multispecies Habitat Conservation Plan (HCP) to obtain a Section 10 ITP. The ITP will ensure that the HPA program complies with the ESA, and will facilitate ESA compliance for citizens conducting work under an HPA.
For WDFW, the benefits of an HCP and ITP are to contribute to the long-term conservation of both listed and unlisted species through the minimization and mitigation of impacts on those species and their habitats, while ensuring that WDFW can legally proceed with the issuance of HPAs that might otherwise result in the incidental "take" of ESA-listed species.

The HCP will identify the impacts of HPA-permitted projects on those aquatic species considered for coverage, the potential for take, and conservation measures for avoiding, minimizing, and mitigating, to the maximum extent practicable, the impacts of the permitted take on the potentially covered species. The Services must find in their biological opinion that any permitted incidental take will not jeopardize the continued existence of the species, ore result in the destruction or adverse modification of designated critical habitat (i.e., the taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild), before they can issue ITPs.

In 2006 – 2008, WDFW worked with contractors to develop a suite of white papers. The white papers compile the best available scientific information for the potential effects of up to 21 types of HPA projects on 52 potentially covered species of fish and shellfish. This compilation includes information from white papers developed in 2006 and 2007. Material developed in 2008 has not yet been peer reviewed (as of April 2009) and is not included here.

The white papers consider hydraulic project impacts in both freshwater and marine environments. Species considered for coverage under the HCP (referred to in this white paper as "HCP species") are listed in Table 1-1. WDFW intends to apply this best available scientific information to protect these species during all of the phases of projects that require a hydraulic permit, including construction, maintenance, repair, operation, replacement, modification, and removal.

In addition to establishing the scientific basis for the HCP, the white papers describe potential take mechanisms. They identify what avoidance, minimization and mitigation measures could address the potential effects of hydraulic projects. They are intended to assist WDFW decision-making regarding what specific HPA activities should be covered by the HCP.

Table 1-1. The 52 HCP species addressed in this white paper.

Common Name	Scientific Name	Status[a]	Habitat
Chinook salmon	*Oncorhynchus tshawytscha*	FE/FT/SC	Freshwater, Estuarine, Marine
Coho salmon	*Oncorhynchus kisutch*	FT/FSC	Freshwater, Estuarine, Marine
Chum salmon	*Oncorhynchus keta*	FT/SC	Freshwater, Estuarine, Marine
Pink salmon	*Oncorhynchus gorbuscha*	SPHS	Freshwater, Estuarine, Marine
Sockeye salmon	*Oncorhynchus nerka*	FE/FT/SC	Freshwater, Estuarine, Marine
Steelhead	*Oncorhynchus mykiss*	FE/FT/SC	Freshwater, Estuarine, Marine
Coastal cutthroat trout	*Oncorhynchus clarki clarki*	FSC	Freshwater, Estuarine, Marine
Redband trout	*Oncorhynchus mykiss*	FSC	Freshwater
Westslope cutthroat trout	*Oncorhynchus clarki lewisii*	FSC	Freshwater
Bull trout	*Salvelinus confluentus*	FT/SC	Freshwater, Estuarine
Dolly Varden	*Salvelinus malma*	FP	Freshwater, Estuarine
Pygmy whitefish	*Prosopiim coulteri*	FSC/SS	Freshwater
Olympic mudminnow	*Novumbra hubbsi*	SS	Freshwater
Lake chub	*Couesius plumbeus*	SC	Freshwater
Leopard dace	*Rhinichthys falcatus*	SC	Freshwater
Margined sculpin	*Cottus marginatus*	FSC/SS	Freshwater
Mountain sucker	*Catostomus platyrynchus*	SC	Freshwater
Umatilla dace	*Rhinichthys umatilla*	SC	Freshwater
Pacific lamprey	*Lampetra tridentata*	FSC	Freshwater, Estuarine, Marine
River lamprey	*Lampetra ayresi*	FSC/SC	Freshwater, Estuarine, Marine
Western brook lamprey	*Lampetra richardsoni*	FSC	Freshwater
Green sturgeon	*Acipenser medirostris*	FT/FSC/SPHS	Freshwater, Estuarine, Marine
White sturgeon	*Acipenser transmontanus*	SPHS	Freshwater, Estuarine, Marine
Eulachon	*Thaleichthys pacificus*	FC/SC	Freshwater, Estuarine, Marine
Longfin smelt	*Spirinchus thaleichthys*	SPHS	Freshwater, Estuarine, Marine
Pacific sand lance	*Ammodytes hexapterus*	SPHS	Marine & Estuarine

Common Name	Scientific Name	Status[a]	Habitat
Surf smelt	*Hypomesus pretiosus*	SPHS	Marine & Estuarine
Pacific herring	*Clupea harengus pallasi*	FC/SC	Marine & Estuarine
Lingcod	*Ophiodon elongatus*	SPHS	Marine & Estuarine
Pacific cod	*Gadus macrocephalus*	FSC/SC	Marine (occ. Estuarine)
Pacific hake	*Merluccius productus*	FSC/SC	Marine & Estuarine
Walleye pollock	*Theragra chalcogramma*	FSC/SC	Marine (occ. Estuarine)
Black rockfish	*Sebastes melanops*	SC	Marine & Estuarine
Bocaccio rockfish	*Sebastes paucispinis*	SC	Marine & Estuarine
Brown rockfish	*Sebastes auriculatus*	SC	Marine & Estuarine
Canary rockfish	*Sebastes pinniger*	SC	Marine & Estuarine
China rockfish	*Sebastes nebulosis*	SC	Marine & Estuarine
Copper rockfish	*Sebastes caurinus*	FSC/SC	Marine & Estuarine
Greenstriped rockfish	*Sebastes elongates*	SC	Marine & Estuarine
Quillback rockfish	*Sebastes maliger*	FSC/SC	Marine & Estuarine
Redstripe rockfish	*Sebastes proriger*	SC	Marine & Estuarine
Tiger rockfish	*Sebastes nigrocinctus*	SC	Marine & Estuarine
Widow rockfish	*Sebastes entomelas*	SC	Marine & Estuarine
Yelloweye rockfish	*Sebastes ruberrimus*	SC	Marine & Estuarine
Yellowtail rockfish	*Sebastes flavidus*	SC	Marine & Estuarine
Olympia oyster	*Ostrea lurida*	SPHS	Marine & Estuarine
Northern abalone	*Haliotis kamtschatkana*	FSC/SC	Marine
Newcomb's littorine snail	*Algamorda subrotundata*	FSC/SC	Marine
Giant Columbia River limpet	*Fisherola nuttalli*	SC	Freshwater
Great Columbia River spire snail	*Fluminicola columbiana*	FSC/SC	Freshwater
California floater (mussel)	*Anodonta californiensis*	FSC/SC	Freshwater
Western ridged mussel	*Gonidea angulata*	None	Freshwater

Notes: For the purpose of this white paper, some of the HCP species have been grouped when appropriate (each group is separated by a gray line).

[a] Status:

FE=Federal Endangered
FP=Federal Proposed
FT = Federal Threatened
FC = Federal Candidate
FSC = Federal Species of Concern
SC = State Candidate
SS = State Sensitive
SPHS = State Priority Habitat Species

2 Objectives

The objectives of the white papers are:

- To compile and synthesize the best available scientific information related to the potential human impacts on HCP species, their habitats, and associated ecological processes resulting from the construction, maintenance, repair, operation, replacement, modification, or removal of HPA-permitted activities.

- To use this scientific information to estimate the circumstances, mechanisms, and risks of incidental take potentially or likely resulting from HPA-permitted activities.

- To identify appropriate and practicable measures, including policy directives, conservation measures, and best management practices (BMPs), to avoid and/or minimize the risks of incidental take of HCP species.

3 Methods

White papers that are included in this compilation were written over the course of two years by several authors at four consulting firms. The white papers are:

Draft Bank Protection/Stabilization White Paper, prepared for Washington Department of Fish and Wildlife by Anchor Environmental, L.L.C. in association with R2 Resource Consultants and Jones & Stokes Associates (2006).

Overwater Structures and Non-structural Piling White Paper, prepared for Washington Department of Fish and Wildlife by Jones and Stokes Associates, in association with Anchor Environmental, L.L.C. and R2 Resource Consultants (2006).

Water Crossings White Paper, prepared for Washington Department of Fish and Wildlife by Jones & Stokes Associates, in association with Anchor Environmental, L.L.C. and R2 Resource Consultants (2006).

Shoreline Modifications White Paper, prepared for Washington Department of Fish and Wildlife by Herrera Environmental Consultants, Inc. (2007).

Marinas and Shipping/Ferry Terminals White Paper, prepared for Washington Department of Fish and Wildlife by Herrera Environmental Consultants, Inc. (2007).

Fish Passage White Paper, prepared for Washington Department of Fish and Wildlife by Herrera Environmental Consultants, Inc. in consultation with Kozmo Ken Bates (Working draft 2008, not to be cited).

Fish Screens White Paper, prepared for Washington Department of Fish and Wildlife by Herrera Environmental Consultants, Inc. (Working draft March 2008, not to be cited).

Channel Modifications White Paper, prepared for Washington Department of Fish and Wildlife by Herrera Environmental Consultants, Inc. (2007).

Flow Control Structures White paper, prepared for Washington Department of Fish and Wildlife by Herrera Environmental Consultants, Inc. (Working draft December 2007, not to be cited).

Habitat Modifications White Paper, prepared for Washington Department of Fish and Wildlife by Herrera Environmental Consultants, Inc. (Working draft December 2007).

One additional white paper was prepared in 2006: Small Scale Mineral Prospecting, prepared for Washington Department of Fish and Wildlife by R2 Resource Consultants, in association with Anchor Environmental LLC (2006). This paper was not included in this compilation, because WDFW is undertaking revisions to the mineral prospecting rules separately. However, WDFW

expects to incorporate changes from that rulemaking into the hydraulic project approval Habitat Conservation Plan.

Each of the white papers prepared in 2006 and 2007 included a description of the methods used to complete the white papers. The level of detail included in each method section varied, though more specific information was provided for papers prepared in 2007.

The methods section for white papers prepared in 2006 (Overwater Structures and Non-Structural Piling, Bank Protection/Stabilization, and Water Crossings) identified five principle tasks that were performed in preparing the white papers:

1. Existing WDFW rules and guidance were reviewed to identify current knowledge and practices relevant to the analysis of the impacts to potentially covered species associated with HCP-permitted activities.

2. A literature review was conducted to compile information reflecting the current state of knowledge regarding potential impacts associated with HCP-permitted activities and the potential to affect potentially covered species.

3. The compiled documents were reviewed to determine which potential pathways of impact were addressed in each document. The vast majority of collected documents considered impacts to salmonids or to physical habitat features, although documents that identified impacts to potentially covered species and their habitats other than salmonids were also identified and evaluated during the literature review.

4. Impact mechanism analyses were prepared for each of the principal impact pathways and for each principal type of HCP-permitted activity.

5. A draft version of this white paper was prepared and reviewed by technical specialists on the consultant team, then submitted to WDFW for comments. The white paper was amended based on the comments provided by WDFW and the white paper was finalized.

The methods section of white papers prepared in 2007 (Marinas and Terminals, Shoreline Modifications, Fish Passage, Fish Screens, Habitat Modifications, Channel Modifications, and Flow Control Structures) stated that information presented in these white papers is based primarily on the compilation and synthesis of the best available scientific information related to human impacts on HCP species, their habitats, and associated ecological processes. The methods used included the acquisition of existing literature, followed by an analysis of impacts based on a review of the literature.

In addition, the methods section of the marinas and terminals white paper specifically stated that best professional judgment was used to draw inferences from other pertinent, similar, or related studies and data sources where specific information was lacking.

WDFW staff subsequently organized, condensed, and edited the information from white papers prepared in 2006 and 2007, and included information resulting from peer reviews.

Each of the white papers listed databases and/or specific references that were consulted. The following tables compile that information.

Table 3-1: Resources used to develop white papers in 2006

Information Source	**2006 white paper**		
	Bank protection	overwater structures	water crossings
Relevant previous white papers prepared for WDFW (exact titles unspecified)	x	x	x
Relevant Washington Administrative Codes (WAC) (Sections unspecified in Methods, but discussed elsewhere in papers)	x		
Integrated Streambank Protection Guidelines (Cramer et al., 2003)	x		x
Stream Habitat Restoration Guidelines (Saldi-Caromile et al., 2004)	x		x
Alternative Mitigation Policy Guidance Interagency Implementation Agreement (Ecology, 2000).	x		
Design of Road Culverts for Fish Passage (Bates 2003)			x
Copies of HPAs provided by WDFW (citations unspecified in Methods)	x	x	x
Biological opinions prepared by NOAA Fisheries and USFWS, addressing various (unspecified) projects in Washington and Oregon	x	x	x
Keyword search of BIOSYS database	x		
Keyword search of Agricola database	x		
Internet (unspecified resources)	x	x	x
Google Scholar® searches	x		
Google searches	x	x	x
Other literature databases (not specifically identified in Methods)		x	x

The methodology sections for the 2006 white papers provided some additional detail:

- The principal keyword search strategy was to look for documents linking terms describing the species (i.e., common and scientific names of potentially covered species) with terms describing HPA-permitted structures or pathways of impact associated with the construction and presence of such structures.

- Additionally, some documents were identified by reviewing the bibliographies contained in documents identified through the preceding searches.

- Documents located during the literature review were in turn used in Internet searches (mostly conducted using the Google® search tool) to locate additional relevant literature addressing specific impact pathways.

Table 3-2: Resources used to develop Channel Modifications, Fish Passage, Fish Screen, Flow Control and Shoreline Modification white papers in 2007

Database	2007 White Paper					
	channel modifications	fish passage	fish screens	flow control	Habitat modifications	shoreline modifications
Thomson Scientific Web of Science (2007) • has electronic access to more than 8,500 scientific journals encompassing all fields of environmental science. • yielded several hundred relevant publications, most published within the last 10 years.	x	x	x	x	x	x
Thomson Scientific Web of Science for individual species • A keyword search of the scientific name and/or common name for each species in Table 1-1 was conducted. • For those species where the search returned more than 1,000 references, a few recent citations were selected for inclusion. Species in this category were the five salmon species (sockeye, chum, pink, coho, and Chinook), steelhead, and coastal cutthroat trout. • For the remaining species, every reference in the search result was reviewed for the relevance of species-specific information to be included in this white paper. • For several species, searches for scientific names and common names returned no references. These species included the margined sculpin, giant Columbia River limpet, great Columbia spire snail, western ridged mussel, river lamprey, longfin smelt, Newcomb's littorine snail, and many of the rockfish species.		x	x	x		
Previous white papers (exact titles unspecified)	x	x	x	x	x	x
Puget Sound-Georgia Basin Research Conferences conference proceedings (2001, 2003, 2005, 2007)	x	x	x	x	x	x
Summit system of libraries searched for theses. • Summit is a library catalog that combines information from Pacific Northwest academic libraries, including the Orbis and Cascade systems, into a single database available at URL = http://summit.orbiscascade.org/	x	x	x	x	x	x
University of Washington School of Aquatic and Fisheries Sciences, Fisheries Research Institute Reports (UW-FRI) database	x	x	x	x	x	x

• includes more than 500 report pertaining to research conducted by Fisheries Research Institute personnel from 1973 to the present.						
Personal collections of Herrera's (the consulting firm that prepared these white papers) staff including "consultant reports, textbooks, etc."	x	x	x	x	x	x

Table 3-3: Resources used to develop Marinas and Terminals white paper in 2007

Database
UW Library catalog • available at http://catalog.lib.washington.edu/search~/
University of Washington School of Aquatic and Fisheries Sciences, Fisheries Research Institute Reports (UW-FRI) database • includes more than 500 report pertaining to research conducted by Fisheries Research Institute personnel from 1973 to the present. • has unlimited Internet access. • http://www.fish.washington.edu/Publications/frireps.html.
Personal collections of Herrera's (the consulting firm that prepared these white papers) staff including "consultant reports, textbooks, etc."
Best professional judgement
NOAA regional library
Northwest Fishery Science Center (NWFSC)
Aquatic Sciences and Fisheries Abstracts (ASFA) • The ASFA database has limited online membership but was accessed through the UW library system. • The ASFA database includes literature dating back to 1982 covering the science, technology, and management of marine and freshwater environments. • It includes 5,000 international sources in the form of primary journals, source documents, books, monographic series, conference proceedings, and technical research reports.
National Technical Information Service (NTIS) • has unlimited Internet access.
UW Urban Water Resource Management database • has unlimited Internet access. • http://depts.washington.edu/cuwrm/.
Seattle Aquarium Salmon Information Center database • has unlimited Internet access.
UW library catalog • has unlimited Internet access.
USDOE Energy Citation Database • has unlimited Internet access • http://www.osti.gov/energycitations/.

The methodology sections for the 2007 white papers provided some additional detail:

To identify data gaps and evaluate the state of scientific knowledge applicable to the potential impacts of HPA-permitted projects on the HCP species and their habitats, the acquired literature was examined to assess the broader issue of how these species use aquatic habitats and how HPA-permitted projects and their construction alter habitat functions.

Existing literature reviews, peer-reviewed journal articles, books, theses/dissertations, and technical reports were reviewed for information specific to aquatic species and their interaction with HPA-permitted projects. Through this process, a collection of information was assembled on the life history, habitat uses, and the potential impacts that these structures pose to HCP species.

Reference material from each of the above databases was compiled in an Endnote personal reference database (Endnote version X). Reference types collected and entered into the database included journal articles, reports, web pages, conference proceedings, theses, statutes, books, and book sections. Each entry in the database included descriptive information, including author(s), year, title, volume, pages, publisher, etc. Whenever an electronic copy of the reference material was available, a link between the reference entry and a PDF copy of the reference material was included in the database. If an electronic (.PDF) copy of a reference was not available, a hardcopy of the material was kept on file. All reference materials cited in the literature review were either linked to the reference database or retained in an associated file as a hardcopy.

Endnote X is the industry standard software for organizing bibliographic information. It features a fully searchable and field sortable database that can contain an unlimited number of references. Reference information is entered into the database either by direct import from online databases or by manually entering the reference information into reference type templates. Once all the references were entered, the database was used for organizational and archival purposes.