Initial Snohomish River Basin Chinook Salmon Conservation/Recovery Technical Work Plan

Executive Summary

Snohomish Basin Salmonid Recovery Technical Committee

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EXECUTIVE SUMMARY

A. INTRODUCTION

The purpose of this document is to provide a technical basis for a chinook salmon conservation and recovery plan for the Snohomish River basin (Water Resource Inventory Area 7). While it is not a comprehensive recovery plan, it is intended to contribute to chinook salmon recovery in the short term and provide a starting point for a longer-term, multi-species salmonid recovery plan.

The Snohomish Basin Salmonid Recovery Technical Committee is composed of approximately thirty representatives of governmental and non-governmental organizations (Appendix A). Members have technical expertise and interest in the conservation and recovery of salmon populations in the Snohomish River watershed. The Technical Committee adopted five principles to guide its efforts in the development of this initial work plan:

1. Emphasize protection and reconnection of habitat;
2. Use historical information to guide today's decisions;
3. Preserve and restore the natural ecosystem processes;
4. Use monitoring and assessment to guide adaptive management; and
5. Preserve options for the future.

B. SNOHOMISH BASIN OVERVIEW

At 1,856 square miles in area, the Snohomish River basin is the second largest watershed draining to Puget Sound (Figure 1). It includes the Skykomish, Snoqualmie, and Snohomish rivers, along with numerous tributaries. This ecosystem supports significant populations of native salmonids including coho, chinook, chum and pink salmon; steelhead, rainbow, cutthroat and bull trout; and mountain whitefish.

Figure 1. Location of Snohomish River basin.

In May 1999, the National Marine Fisheries Service (NMFS) listed the Puget Sound chinook salmon stocks as threatened under the Endangered Species Act (ESA). This listing includes the stocks native to the Snohomish River basin.

C. PROCESSES THAT FORM AND MAINTAIN HABITAT

Salmon in the Pacific Northwest have evolved through complex interactions with their freshwater, estuarine, and marine environments. These environments are created and maintained by physical, chemical and biological processes acting over a range of spatial and temporal scales. Though salmon have existed for several million years, conditions in the Snohomish River basin were largely reset 6 – 8,000 years ago following the most recent glacial period. Since that time the major processes forming and maintaining habitat have included:

- Precipitation in the form of snow and rain creating conditions for runoff;

- Redistribution and sorting of sediment based on energy gradients and sources;
- Migration of channels across their floodplains creating habitat with a diversity of flow conditions, food supplies, cover, and substrate conditions;
- Vegetative growth of long-lived species that play a dominant role in modifying local energy gradients and sediment dynamics; and
- The development of a plethora of biological niches at all scales.

The environment includes disturbance, even in the pre-development situation, by geologic mass movement, fire, flooding and disease outbreaks. Over the spatial scale of the basin and the temporal scale of several thousand years, such disturbances are local and short-lived. The resulting natural environment is locally diverse, yet regionally predictable.

Large-scale disruption and acceleration of these processes has occurred since the 1850s. Human activities have fundamentally changed the way water, wood and sediment move through the watershed. Hydromodifications (dikes, levees, revetments, etc.) have further affected sediment dynamics, flood frequency and levels, and nutrient dynamics. These changes have affected the life cycles of salmon in the Snohomish River basin.

D. STATUS OF THE POPULATION

This report focuses on chinook salmon (*Oncorhynchus tshawytscha*) populations that spawn and rear in the Snohomish River basin. In the absence of biologically determined productivity goals, fishery biologists use the average annual escapement from 1965 – 1976 as a target escapement level. For the Snohomish River basin, the target is 5,250 fish returning each year. For comparison, the most recent available 12-year average was 4,013 fish from 1987 – 1998 (Figure 2).

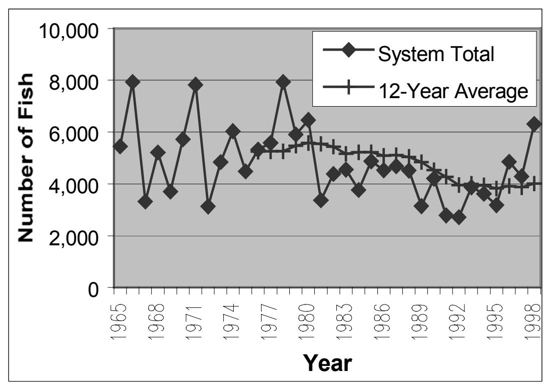

Figure 2. Summary of chinook salmon escapement in the Snohomish River basin, 1965 – 1998.

Naturally spawning chinook salmon in the Snohomish River basin are divided into four stocks. The division is based on differences in spawning timing, geographical spawning distribution and genetic characteristics.

- Snohomish River Summer. The escapement of this stock has been declining, and 1997 had the lowest escapement ever recorded. The proximity of the Wallace River hatchery may lead to significant straying of hatchery fish into the spawning area.
- Snohomish River Fall. In contrast to the general downward trend for chinook salmon escapement in the basin, the escapement for this stock has been increasing.
- Bridal Veil Creek Fall. Escapement has dropped substantially since the mid-1970s.
- Wallace River Summer/Fall. The Wallace River stock is considered to be a mixture of stocks resulting from hatchery straying and natural production. This stock was considered healthy in 1993, but recent escapements have been down from the 1965-1976 base year period.

E. FACTORS AFFECTING THE POPULATION

1. Marine Survival

Ocean conditions are cyclic, and the ocean's carrying capacity for salmonids is dynamic in time and space. Salmon populations naturally exhibit highly variable abundance. Currently, Puget Sound stocks generally appear to be experiencing a period of lower than average marine survival.

While predation is a factor, it is part of the natural ecosystem in which salmon evolved. In the North Pacific Ocean, approximately fifteen species of marine mammals reportedly eat salmon. Although salmon are not their primary prey, seal and sea lion predation can have significant impacts on salmon populations when those populations are already depressed by other factors.

2. Harvest

Chinook salmon from Puget Sound are harvested throughout much of their marine residency in ceremonial, subsistence, commercial, and recreational fisheries from Alaska to Puget Sound. In most cases, fishing mortality on Snohomish River chinook salmon is incidental to fisheries targeting other stocks or species. Estimated exploitation rates on the Snohomish River chinook salmon management unit declined steadily from approximately 80% in the late 1970s to approximately 55% in the mid-1990s. The rates have likely declined further in the late 1990s, to as low as 35%, because of increased restrictions on fishing.

3. Artificial Production

Chinook salmon have been produced and released into the Snohomish River basin for the past century. This production poses potential risk to wild populations in the basin in three ways:

- Introgression of genes from hatchery populations into wild populations;
- Adverse effects from competition, predation and other ecological factors; and
- Masking the true status of wild fish due to large numbers of hatchery fish.

The State and Tribal co-managers are examining and evaluating these risk factors through intensive marking and monitoring of hatchery production at the Wallace River and Tulalip hatcheries and modification of hatchery programs where appropriate. The Snohomish River system is managed primarily for wild production and only secondarily for hatchery production of all species of salmonids. Currently, fisheries targeted at hatchery production occur only where hatchery fish can be separated in space and time from wild fish, as in Tulalip Bay, or through visible mass marking of hatchery fish and implementation of selective retention regulations.

4. Hydropower

Unnatural fluctuations in stream flow occur downstream of hydroelectric facilities, based on how the facility is designed and operated. Water level fluctuations associated with hydropower operations may reduce habitat availability, de-water spawning areas, restrict access or strand fish, or affect the migratory behavior of juvenile salmonids. Instream flow schedules, minimum flow requirements, and down-ramping prescriptions are operational means of protecting the aquatic resources downstream of hydroelectric facilities. Hydroelectric dams may also modify sediment and woody debris transport, water temperatures and the concentration of dissolved gasses.

Two types of hydroelectric operations are present in the Snohomish River basin: storage facilities and run-of-the-river facilities. The Henry M. Jackson and the South Fork Tolt River hydroelectric projects are both storage facilities. The remaining projects in the basin are run-of-the-river operations with little or no storage, and they are all upstream of natural barriers to anadromous fish migration.

5. *Freshwater and Estuarine Habitat*

a) Human Populations and Land Use

Important human land uses in the basin include forestry, urban, residential, light industrial, infrastructure (roads and railroads; gas, water and power lines), recreation, agriculture and mining. The Snohomish River basin is a major source of municipal water supply for Everett, Seattle, southwest Snohomish County and other areas. Human population in the basin is projected to increase by 53% from 206,000 in 1995 to 315,000 in 2020. Types of land use, population densities and likely impacts on chinook salmon habitat vary greatly across the watershed, so they are considered separately for the following five sub-basins (Figure 3).

- Snohomish River Estuary and Nearshore Areas. This 154 square mile area is the most heavily urbanized portion of the Snohomish River basin. Major land uses include urban, residential, agriculture, transportation and commercial/industrial. The natural conditions have been heavily modified throughout this sub-basin.

- Snohomish River Mainstem. This 178 square mile sub-basin includes the Pilchuck River and tributaries that empty into the Snohomish River below the confluence of the Snoqualmie and Skykomish rivers. The majority of the land is designated for rural residential uses, and approximately 20% of the basin is forested. Agricultural use occupies the floodplain.

Figure 3. Sub-basins of the Snohomish River basin.

- Skykomish River Mainstem. The Skykomish River mainstem and its tributaries (below the confluence of two major forks near Index) drain 325 square miles, more than three-quarters of which are forested hills and mountains. The most common land use outside the forests is residential, with extensive agriculture in the floodplain.

- Skykomish River Forks. This sub-basin drains 507 square miles, 98% of which are forested. Low density residential development along the valley floors makes up most of the rest of the land use.

- Snoqualmie River. The Snoqualmie River watershed comprises 692 square miles. Predominant land uses are forestry, covering 75% of the area, agriculture and residential. There is potential for high-density development in some areas.

b) Interaction of Human Populations, Land Use and Habitat Conditions

Over the past 150 years, human activities have altered the habitat used by salmon and disrupted the natural processes that maintain it, although some areas still support natural functions. Physical changes that affect chinook salmon habitat have included loss of wetlands; placement of roads, railroads, levees, and revetments in areas that cut off side channel habitat or limit the natural process of channel migration; bank stabilization; diking; dredging; gravel mining in the floodplain; development and filling of the floodplain; clearing and road-building on unstable slopes; removal of trees and large woody debris; log rafting; water withdrawals; and construction of fish passage barriers and impervious surfaces. These changes alter the hydrology, channel morphology, sediment transport and other processes that maintain salmon habitat.

For example, rip-rapping, diking and dredging confine river channels to their present courses to prevent channel flows from reaching the floodplain. This interferes with the natural process of recruiting large woody debris and depositing sediment across the floodplain. Dredging can also lower the water table, which in turn affects stream temperatures and water flows.

c) Factors Contributing to Decline

The Technical Committee examined freshwater and estuarine habitat conditions in the basin and considered how they may limit the productivity of salmon in four ways:

- Loss of rearing habitat quality and quantity;
- Decreased egg to emergent survival;
- Acute juvenile mortality; and
- Adult mortality.

The Technical Committee identified several problems that contribute to the degradation of habitat and the subsequent decline in chinook salmon productivity. They evaluated each of these problems and identified nine which are the highest priority for salmon recovery in the basin:

1. Loss of channel area and complexity due to bank protection and diking of the river and major tributaries, cutting off the channel from its floodplain;
2. Dearth of in-channel large woody debris;
3. Flood flows that scour redds at high frequencies;
4. Increased sediment input to streams as a result of slope failures;
5. Poor quality riparian forests;
6. Loss of wetlands due to draining for land conversion that eliminates habitat and reduces water retention;
7. In redd mortality due to siltation or water quality contamination;
8. Urbanization (road construction, commercial and residential construction, additional bank hardening) that further reduces chinook salmon viability in the basin; and

9. Artificial barriers (dams, tide gates, diversions, culverts, pump stations) that prevent juveniles from reaching rearing habitat.

These are not the only problems and they are not entirely independent. They serve as a starting point to guide early actions to protect chinook salmon. Activities undertaken to improve our understanding of the highest priority problem statements, as presented above, will provide critical support to the long-term recovery plan.

d) Remaining Critical Habitat and Linkages

Preservation of remaining functioning habitat is typically far more cost-effective than habitat restoration. Protecting these areas is critical to successful recovery efforts and is accorded a high priority by the Technical Committee. Work remains to identify specific sites for preservation and to determine how best to protect them. As a first step, the Technical Committee listed areas of critical habitat in each sub-basin that still support some natural processes. These are summarized in Table 1.

Table 1. Summary of remaining critical habitat and linkages.

Sub-Basin	Remaining Critical Habitat and Linkages
Snohomish River Estuary	Wetlands, sloughs, emergent marsh and forested transition zones.
Snohomish River Mainstem	Forested riparian corridors without dikes or rip-rap, off-channel habitat.
Skykomish River Mainstem	Forested riparian corridors without dikes or rip-rap, the braided reach.
Skykomish River Forks	Beckler, Tye, and Foss river catchments; the North Fork Skykomish River to Bear Creek Falls; habitat above Bear Creek Falls.
Snoqualmie River	Forested riparian corridors without dikes or rip-rap; Griffin and Tokul creek catchments; spawning areas in Snoqualmie, Raging and Tolt rivers.
Basin-wide	Unditched floodplain tributaries with riparian vegetation.

6. Non-Native Species

Concern is growing over the environmental impacts of animal and plant species that originate from other areas. The control and eradication of non-native species poses a serious challenge. The implications of non-native species to an ESA-listed species such as chinook salmon and its ecosystem are unknown at this time because of a lack of data and information. The initial statewide effort has been to establish baseline inventory information in Puget Sound and develop planning and regulatory activities within the context of federal strategy.

7. Data Gaps

The Technical Committee identified several important gaps in the available information as it assembled this initial work plan. They are listed in the main document to guide development of a research program to support salmon recovery.

F. ACTIONS

Based on the best available scientific information, the Technical Committee has assembled a set of initial actions that could be undertaken to conserve and recover chinook salmon in the Snohomish River basin. These actions are designed to protect and enhance salmon populations and their habitat. The Technical Committee has largely deferred consideration of social, economic and other non-technical impacts. Analysis of those other considerations is an important next step.

Chinook salmon recovery depends on many factors, including harvest, artificial production and habitat management. No single factor can individually bring about successful recovery. The Technical Committee recommends the actions in this document for consideration in developing a chinook salmon conservation and recovery plan.

1. Harvest Management Plan

A new chinook salmon harvest management plan should be developed based on a better understanding of the processes that govern population dynamics, once that is available. In the meantime, harvest management should:

1. Maintain the exploitation rate on each brood below a maximum level set such that harvest will not impede the ability of the stocks to rebuild;
2. Maintain escapement for each stock above a minimum level to assure the continued viability of each stock;
3. Reduce fishery-induced size and age selectivity; and
4. Continually monitor the results and modify the plan as required to meet the goals.

2. Artificial Production Management Plan

Snohomish River chinook salmon are managed primarily for natural production. Artificial production is provided to achieve defined objectives consistent with the principle that the risks to natural production caused by artificial production will be minimized. The State and Tribal co-managers of the fishery should review existing artificial production programs in the Snohomish River system to identify aspects that could be modified to reduce risks to the natural stocks of chinook salmon. Any newly proposed artificial production projects should be evaluated for risk to wild chinook salmon stocks and approved only if the risk will be minimal. Monitoring of the operations and impacts of the Tulalip and Wallace River hatcheries should be conducted to ensure that the programs are consistent with the recovery of wild stocks.

3. Habitat Management Plan

Based on the guiding principles, the Technical Committee compiled a list of actions to improve salmon habitat. There is no succinct way to summarize the whole list. In keeping with the principle that places primary emphasis on protection and reconnection of habitat, the protection recommendations for each of the nine problem areas are summarized in Table 2. The main document lists many more, including restoration, enforcement, research and education actions.

Table 2. Summary of recommended protection actions for priority habitat problems.

Problem	Recommended Protection Actions
Loss of channel area and complexity	Prevent any additional modification of undisturbed/natural banks in the basin. Prohibit floodplain land uses that are incompatible with channel meandering and natural flooding. Identify and acquire stretches of undisturbed river corridor that continue to function unimpaired.
Dearth of large woody debris (LWD) in channel	Prevent further removal of LWD from stream channels within the basin. Protect remaining riparian zones to provide a future source of LWD. Protect mature riparian forests through acquisitions or easements.
Flood flows that scour redds	Prevent floodplain land uses and practices that are incompatible with natural processes. Prevent loss of wetlands and side channels and the proliferation of impervious surface in the basin. Maintain forest cover to the greatest extent possible. Acquire floodplain land as open space.
Increased sediment input to streams	Prevent actions in landslide hazard areas that contribute to mass wasting. Acquire landslide hazard areas. Prohibit logging on sensitive slopes. Require slope stability analysis prior to road building or timber harvesting. Employ innovative road designs to reduce sediment inputs.
Poor quality riparian forests	Prevent further clearing or other alterations of forests along streams. Locate roads, utility corridors and other infrastructure away from streams and rivers. Preserve remaining healthy riparian forests.
Loss of wetlands	Prevent the loss of wetlands. Protect sites from deleterious inputs, such as herbicides. Purchase wetlands.
In redd mortality due to siltation and water quality	Ensure that clearing and other activities do not contribute sediment to streams. Limit location and extent of road building. Prohibit any new bank armoring. Require and enforce best management practices.
Urbanization that reduces chinook salmon viability	Limit urban development to areas away from floodplains, riparian corridors, wetlands and headwaters. Maintain stream corridors. Limit impervious surfaces. Encourage greater concentration of population in urban areas. Ensure public works activities protect streams. Ensure developments manage storm water to preserve natural hydrographs.
Artificial barriers that block juvenile and adult migration	Stop alterations of the floodplain and placement of fish passage barriers. Evaluate fish passage for new projects and use bridges for stream crossings.

4. Multi-Jurisdictional Programmatic Assessment

Land use and development regulations are two of the most powerful governmental influences that affect salmon habitat. For recovery to take place, current watershed conditions and the policies regulating them must be changed to reestablish the natural conditions that shaped the evolution of salmon. The Technical Committee recommends conducting a comprehensive multi-jurisdictional programmatic assessment. The results should be used to modify regulations and programs to reduce impacts on salmon habitat.

5. Non-Native Species

At this time, the impact of non-native plant and animal species on chinook salmon is not well understood. Additional work will be required to determine what non-native species management actions, if any, will be required at the watershed level.

6. Monitoring and Adaptive Management

Adaptive management is an approach that incorporates monitoring to allow activities to go forward in the face of some uncertainty regarding consequences. The key provisions are:

- An explicit hypothesis concerning the objectives of an activity;
- Monitoring or research designed to test the hypothesis; and
- Provisions for changing the activity in response to information or knowledge gained.

Attempts at recovery should not be delayed until the outcomes can be precisely predicted because the damage to chinook salmon populations and habitat could become irreversible in the meantime. Instead, actions can be initiated while the outcomes are still uncertain, provided that a monitoring and adaptive management strategy can help guide changes to the program based on new information as it becomes available.

G. NEXT STEPS

This document is intended to provide a technical foundation for a chinook salmon recovery plan. The actions put forward in this initial work plan are based on technical evaluations. That is, they represent what is best for the fish. Many of the actions have additional policy implications, including costs and benefits, that should be explored before a recovery plan is finalized.

The Technical Committee will present this initial work plan to the Snohomish Basin Salmonid Recovery Forum, a group of elected officials and stakeholder representatives drawn from the Snohomish River basin area. The Forum has chartered a subcommittee, known as the Synthesis Committee, to identify policy implications and implementation alternatives stemming from this initial work plan. Over the next several months, the Technical Committee will work in partnership with the Forum and the Synthesis Committee to transform these initial technical recommendations into a set of specific recommendations for chinook salmon recovery in the Snohomish River basin. The Technical Committee will also identify specific geographical areas that should be considered as high priority areas for recovery actions.

As the initial chinook salmon recovery plan is developed further and implemented, the Technical Committee will begin work on a long-term, multi-species salmonid recovery and conservation plan for the Snohomish River basin, as part of the Tri-County and State effort to recover salmon.

APPENDIX A

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