CHAPTER 1

Background, Organization, and Overview of the Study

1.1 Introduction to Study

This document presents the final report of a five-year research study in agricultural areas of King County, Washington, within the Puget Sound lowland area where Chinook salmon (*Oncorhynchus tshawytscha*) and other salmonids (*Oncorhynchus spp.*)are present. This study investigated how salmonid habitat in these agricultural areas can be protected while concurrently providing local farmers with the technical and regulatory means to maintain farmable land. Our approach combined the scientific research expertise of two major universities with on-the-ground knowledge and community connections of a major local natural resource agency. The goal of the study was to determine effective and economical methods to maintain agricultural watercourses while protecting fish habitat. Tangible outcomes of our approach resulted in: 1) a significant increase in knowledge about salmonid habitat utilization in low-gradient agricultural watercourses; 2) a set of decision support materials that will assist regulators in evaluating permit applications from farmers who want to maintain the agricultural drainage channels on their lands and; 3) determination of effective and economical means to maintain agricultural watercourses with further degrading fish habitat. The knowledge gained during this project may be incorporated into a Habitat Conservation Plan (HCP) submitted by King County under the authority of Section 10(a)(1)(B) of the federal Endangered Species Act (ESA) for agricultural practices in water bodies that constitute critical habitat for listed species as defined by the Act.

Productive agricultural lands and the rural communities it supports are vital to all residents of King County. Agricultural practices in this region occur mainly in active floodplain areas where fish habitats exist. Since the availability of habitat has been identified as one of the key factors in restoring declining salmon populations and protecting threatened and endangered fish species (PSTRT 2003), a great deal of attention has been placed on agricultural best management practices (BMPs) that are compatible with fish conservation. King County is committed to ensuring that its actions and the programs it administers will contribute to the conservation of native species, with particular emphasis on ESA-listed species.

In 1979, the voters of King County passed an initiative protecting farmland through the purchase of development rights. This initiative provided for a bond to establish the King County Farmland Preservation Program (FPP), which purchases the development rights associated with livestock and horticultural farmlands to protect them from development. Many of the sites used in this study are enrolled in the FPP.

King County's Agricultural Production Districts (APDs) are composed of approximately 40,600 acres (16,430 hectares) zoned for agricultural use. The APDs are located almost exclusively on the floodplains of major rivers, with the exception of the Enumclaw Plateau APD. However, agricultural activities in the Enumclaw Plateau APD occur on similar extremely flat land, and

often affect channels and riparian zones with similar characteristics to those on the valley floors surrounding large rivers. King County's agricultural areas are closely associated with an extensive drainage network and spread out throughout the County (Figure 1-1). As estimated from GIS technology and existing maps, approximately 483 kilometers (300 miles) of watercourses, excluding the mainstems (and braids) of the major rivers, flow through King County's five APDs: Lower Green River, Upper Green River, Enumclaw, Sammamish, and Snoqualmie.

Over time, many floodplain areas within these APDs have become subject to more frequent and prolonged flooding and as a result extended conditions of saturated soils. Accumulation of fine sediments and invasive grasses such as reed canarygrass (*Phalaris aundinaceae,* RCG) in agricultural drainage networks has added to this dilemma, and leads to repeated flooding. These recurrent and persistent conditions are of greater concern to agricultural landowners than are major floods that occasionally inundate extensive valley floor areas. Both the livestock and the horticultural sectors of the agricultural industry have routinely removed sediment and vegetation from agricultural watercourses to alleviate chronic flooding of their lands over the last 150 years. Even crops normally thought of as needing wet soil, such as blueberries, do not thrive in such highly saturated soils. Yet, the customary method of maintaining watercourses by dredging is contrary to some of the current fish habitat protection, mitigation, and in some instances restoration requirements. Anecdotal reports from various areas within King County indicate that the need for maintenance of agricultural drainage channels has increased in recent decades due to increased runoff from urban and suburban development on the slopes above many of the farming areas, increasing the frequency of necessary maintenance for the agriculturist.

Little information exists regarding the specific relationship between land use activities in the agricultural lowlands and fish habitat (Sommer et al. 2001). There is limited published information on salmonid use of small watercourses associated with agricultural areas in King County's riverine floodplains and on the Enumclaw Plateau (Berge 2002). Because of the lack of information concerning the basic salmonid usage of these small watercourses, data derived from studies of salmonid habitat utilization in forested and urban areas are often applied to land use decisions involving agricultural waterways. Clearly, the use of such data to determine the effects of drainage activities or the appropriateness of mitigation practices is highly questionable and needs to be subjected to scientific scrutiny. In many instances these sources are inappropriate for use in defining mitigation, BMPs, or even the habitat requirements for salmonids that utilize agricultural watercourses (Berge 2002).

In order to investigate ways to avoid or minimize agriculture-related impacts on fish habitat, King County initiated its Agricultural Drainage Assistance Program (ADAP). The goal of this program is to provide assistance to landowners interested in maintaining drainage in agricultural waterways in accordance with King County's Critical Areas Ordinance and clearing and grading code. In furtherance of these goals, this study was initiated under conditions set forth in ESA Section 10(a)(1)(A), resulting in the issuance of a "take" permit from by the National Marine Fisheries Service (NMFS) and United States Fish and Wildlife Service (USFWS). The intent of this study was to learn more about the effects of agricultural watercourse maintenance and mitigation and about the effectiveness of BMPs intended to protect salmonids from adverse impacts of agricultural watercourse maintenance.

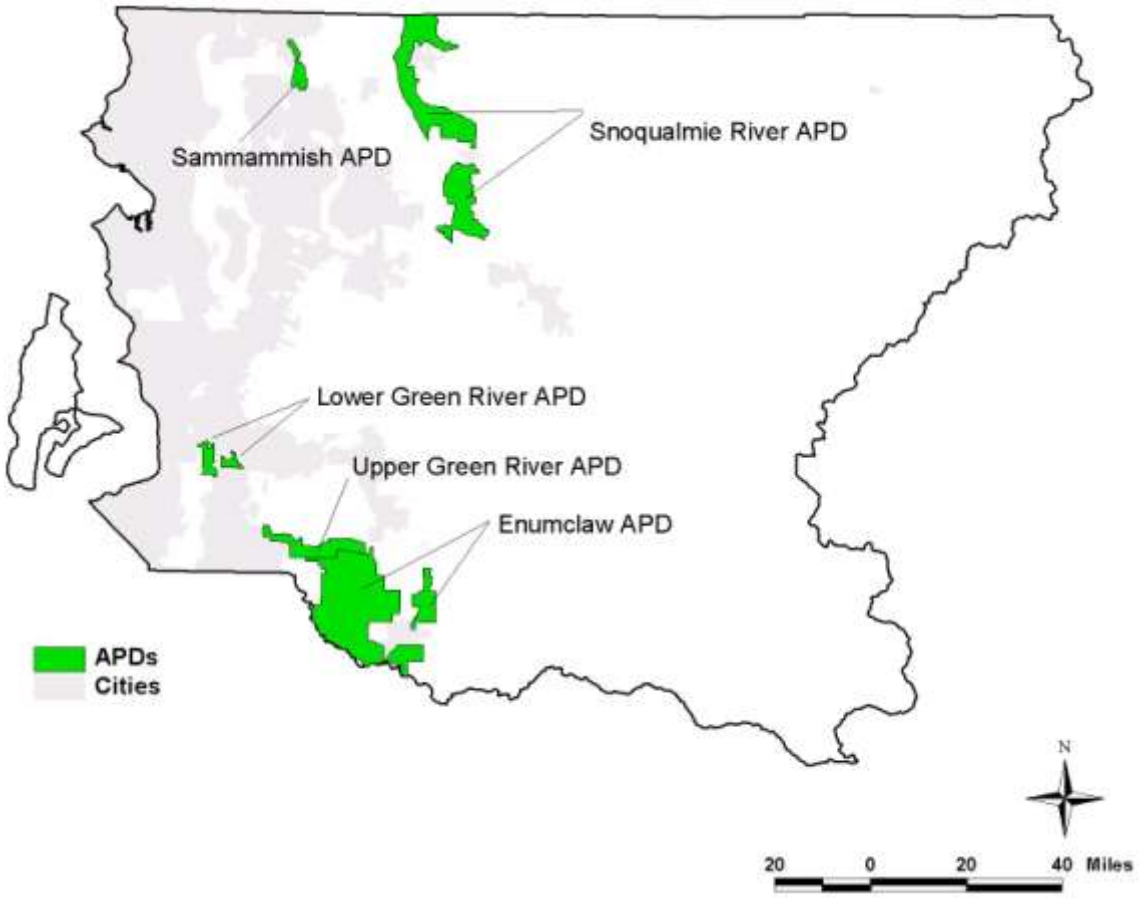

Figure 1-1. Locator map for Agricultural Production Districts (APDs) within King County

The proposed project was intended to provide consistent and comprehensive information on the natural habitat quality, the extent of salmonid use of King County's floodplain habitats, and how to avoid, minimize, and otherwise mitigate agriculture-related impacts on ESA-listed salmonids and their habitat. Additionally, the information garnered from this study will enable King County staff to make decisions relating to allocation of resources as well as to establish work priorities in the county's agricultural areas. Furthermore, the study findings can be shared with other government partners in the region in order to develop and implement programs that address salmonid use of floodplain habitats, and aid in their understanding of effective BMPs for routine maintenance of agricultural drainage channels. This project employed multi-disciplinary expertise, including fish biology, physical sciences, engineering, aquatic ecology, and ecological sciences in addition to a working knowledge of the County's agricultural industry and community.

1.2 Overview of Study Goals

The ultimate aim of this research was to determine effective and economical mitigation practices for the maintenance of agricultural watercourses, so that land in agricultural production can be maintained in such a manner that fish habitat is not degraded below pre-project levels. Specific objectives of the project, as defined through collaboration of the research team and King County Department of Natural Resources and Parks (KCDNRP) staff, are:

- To evaluate both reach-specific and upstream factors that influence the functioning of lowland agricultural watercourse habitat for salmonid fishes,
- To assess the effects of agriculture-related drainage maintenance activities on these factors, and
- To identify drainage maintenance activities that can be undertaken to effectively avoid and minimize adverse habitat impacts.

The objectives of the project are reflected in specific questions answered through fish sampling, water quality, and vegetation research activities. The research activities include establishment of hypotheses, field data collection and monitoring, mathematical modeling, and data analysis. These activities were in support of the 12 major study questions summarized in Table 1-1. To the maximum extent practicable, each subsequent chapter in the report was written as a stand-alone section addressing the corresponding study goal.

Table 1-1. Scope of Work as defined by contract

Area of Study	Chapter	Task	Methodology	Product
Fish Biology	2	Determine if the County's agricultural watercourses serve as habitat for Chinook and other salmonids. If so, determine the habitat functions provided in these watercourses	1) Monitor major physical attributes 2) Field collection of fish 3) Macroinvertebrate collection 4) Water Quality monitoring. 5) Modeling of water temperatures and dissolved oxygen (DO)_	Statistical conclusion based on field data and modeling results
	3	Determine a reliable methodology to estimate fish populations in reed canary grass (RCG) dominated habitats; alternatively, identify an index applicable across the range of habitats	1) Indices 2) Stocking hatchery fish in blocked areas (contingent on approval by regulators)	Develop a tested method
	4	Determine a method for the safe and effective removal of fish prior to excavation ("defishing")	1) Protocol 2) May stock channel segments with know numbers of fish	Subjective and/or statistical conclusion based on field data
	5	Determine if salmonid distribution in agricultural watercourses is preferentially associated with woody debris	1) Initial literature review 2) Direct comparison of fish density in wooded reaches with unwooded reaches	Statistical conclusions based on field data
Instream Habitat	6	Investigate whether dissolved oxygen levels in agricultural watercourses are different from non-agricultural waters, and if low DO is ameliorated by maintenance activities	1) Water quality monitoring 2) Modeling	Develop a computer model for DO prediction

Instream Habitat	7	Investigate whether woody debris, as installed by King County, creates hydraulic diversity in agricultural lands	1) Physical survey 2) Field data collection	Statistical conclusion based on field data
	8	Determine if RCG regimes provide positive, negative, or neutral value to salmonids when compared to reference systems with no vegetation and with intact riparian vegetation	1) Comparison of differences among regimes including: (1) available prey items, (2) stomach contents, (3) condition factors	Statistical conclusion based on field data
Riparian	9	Determine if water temperature differentials exist among different vegetation regimes	1) Water quality monitoring 2) Modeling	Develop a computer model for temperature prediction
	10	Determine successful methods for RCG control/eradiation	1) Investigate method to establish riparian in RCG-susceptible habitats 2) Determine vegetation that provides maximum shade and insects	Develop and demonstrate a tested method
Sediment	11	Develop technology to minimize "first flush" sediment mobilization	1) Field test of site-specific erosion control methods	Develop and demonstrate a tested method
	12	Evaluate techniques to extend maintenance cycles	1) Analytical evaluations 2) On-site measurements	Recommended procedure
	13	Determine characteristic indicators indicating excavation will improve drainage	1) Develop a spreadsheet for Manning's equation 2) Determine impact of water surface elevations	Spreadsheet with Manning's n or similar

1.3 Project Data Files

A considerable amount of data was collected over the five year period in support of the study goals previously outlined. At the request of KCDNRP staff, this information was stored in a format that would make the data readily available to future users. The data CD at the end of this report consists of a readme.txt file and two primary file folders (Location_Maps and Database). The Location_Maps folder contains aerial JPG images of the site locations used in the study. The Database folder has two sub-directories (Shapefiles and Data_Tables). The Shapefiles directory contains ArcInfo files showing sample location points and reaches. This information can be linked with the tables contained in the Data_Tables sub-directory by an experienced GIS user to see the values and locations of the various sampling information.

The Data_Tables sub-directory has both Excel and DBF files that can be accessed directly without the use of GIS although identifying precise locations this way is difficult. An Excel file documenting location names is included to help in this process. This was also included to provide a record of various names of particular sites during the study as land ownership or additional clarification at sites occurred.

1.4 References

Berge, H.B. 2002. 2001 Annual Monitoring Report. King County Agricultural Drainage Assistance Program. King County Department of Natural Resources and Parks. Available at: ftp://dnr.metrokc.gov/dnr/library/2002/kcr763.pdf

PSTRT (Puget Sound Technical Review Team). 2003. Final draft: Independent populations of Chinook salmon in Puget Sound. December 8, 2003 Report to NOAA Fisheries, Seattle, WA. 61 pp.

Sommer, T.R., M.L. Nobriga, W.C. Harrell, W. Batham, and W.J. Kimmerer. 2001. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. Can. J. Fish. Aquat. Sci. 58: 325-333.