

**TABLE OF CONTENTS**

Table of Contents ..... i

List of Tables ..... iv

List of Figures ..... vi

List of Appendices ..... vii

1. INTRODUCTION ..... 1

    1.1. Problem Statement..... 1

    1.2. Regulatory Context..... 7

    1.3. Purpose..... 8

    1.4. Scope ..... 9

    1.5. Plan Organization ..... 10

2. GOALS..... 13

    2.1. Watershed Vision..... 13

    2.2. Near-Term Priorities..... 13

    2.3. Treaty Rights..... 14

    2.4. Biological Goals ..... 15

        2.4.1. Chinook ..... 17

        2.4.2. Bull Trout ..... 19

3. BACKGROUND..... 21

    3.1. Basin Description ..... 21

        3.1.1. Introduction ..... 21

        3.1.2. Nooksack River Watershed ..... 22

        3.1.3. Independent Coastal Tributaries ..... 23

        3.1.4. Fraser River Tributaries ..... 25

        3.1.5. WRIA 1 Estuarine and Nearshore Areas ..... 26

    3.2. Listed Salmonid Populations ..... 28

        3.2.1. Chinook Salmon..... 28

        3.2.2. Bull Trout (and Dolly Varden)..... 40

4. LIMITING FACTORS..... 62

    4.1. Habitat ..... 62

        4.1.1. Identification and Prioritization of Limiting Factors and Habitats ..... 63

        4.1.2. Description of Limiting Factors ..... 65

        4.1.3. Nooksack Early Chinook ..... 72

        4.1.4. Nooksack Bull trout..... 134

    4.2. Harvest ..... 145

        4.2.1. Abundance Impacts ..... 145

        4.2.2. Genetic Diversity Impacts..... 151

        4.2.3. Ecosystem Impacts..... 152

        4.2.4. Bull Trout ..... 153

4.3. Hatcheries .....	155
4.3.1. Genetic Diversity.....	156
4.3.2. Ecological Interactions.....	161
4.4. Hydropower .....	164
4.4.1. Existing Projects .....	164
5. MANAGEMENT STRATEGIES AND ACTIONS.....	168
5.1. Habitat .....	168
5.1.1. Recovery Objectives.....	168
5.1.2. Other Objectives.....	168
5.1.3. Coordination with Watershed Management Plan .....	168
5.1.4. Guiding Principles for Habitat Restoration and Protection .....	169
5.1.5. Habitat Targets .....	170
5.1.6. Early Chinook Strategy .....	170
5.1.7. Bull Trout Strategy.....	200
5.1.8. General Salmonid Recovery Strategies.....	200
5.2. Harvest .....	226
5.2.1. Recovery Objectives.....	226
5.2.2. History of Harvest Management .....	227
5.2.3. Management Processes .....	230
5.2.4. Harvest Management Tools .....	234
5.2.5. Guiding Principles for Managing Harvest Impacts on Nooksack Early Chinook .....	239
5.2.6. Escapement Goals .....	241
5.2.7. Harvest Management Actions and Strategies.....	242
5.2.8. Specific Harvest Actions .....	246
5.2.9. Data Gaps .....	247
5.3. Hatchery.....	252
5.3.1. Recovery Objectives.....	252
5.3.2. Other Objectives.....	252
5.3.3. Guiding Principles .....	252
5.3.4. Management Strategies and Priorities .....	253
5.3.5. Specific Hatchery Actions.....	259
5.3.5. Long-term Actions .....	261
5.4. Hydropower .....	263
5.4.1. Recovery Objectives.....	263
5.4.2. Other Objectives.....	263
5.4.3. FERC Authority.....	263
5.4.4. Management Strategies and Priorities .....	263
5.5. Integrated .....	265
5.5.1. Recovery Objectives.....	265
5.5.2. Other Objectives.....	265
5.5.3. Guiding Principles .....	265
5.5.4. Management Strategies and Priorities .....	265

WRIA 1 SALMONID RECOVERY PLAN

6. IMPLEMENTATION..... 267

6.1. Monitoring and Adaptive Management..... 267

6.1.1. Research..... 267

6.1.2. Salmonid Populations ..... 270

6.1.3. Monitoring ..... 271

6.1.4. Decision-making Structure ..... 274

6.1.5. Timeline for Development of Adaptive Management Program..... 274

6.2. Education and Outreach ..... 274

6.3. Preliminary Funding Estimates ..... 276

6.4. Commitments ..... 276

LITERATURE CITED ..... 289

**LIST OF TABLES**

**Table 1.1.** Salmonid Stocks in Water Resource Inventory Area (WRIA) 1, as identified in Washington Salmonid Stock Inventories. .... 3

**Table 2.1.** Recovery Goals for WRIA 1 Chinook Populations by Viable Salmonid Population (VSP) parameter. .... 16

**Table 2.2.** Recovery Goals for WRIA 1 Bull Trout Populations by core population and population parameter. .... 20

**Table 3.1.** Current and historic salmonid habitat in WRIA 1. .... 55

**Table 3.2.** WRIA 1 Regions and Subbasins. .... 55

**Table 3.3.** Escapements from 1993-2004 for Nooksack early chinook populations. .... 56

**Table 4.1.** Environmental attributes rated for each of 88 reaches in the Nooksack River watershed for input into EDT. .... 138

**Table 4.2.** Examples of guidance for rating of EDT environmental attributes. .... 139

**Table 4.3.** Life stage use of Nooksack Early Chinook Geographic Areas. .... 140

**Table 4.4.** Natural-origin escapement of early chinook to the North / Middle Forks and South Fork of the Nooksack River. .... 146

**Table 4.5.** The total number of natural early chinook spawners (i.e., hatchery- and natural-origin) in the North / Middle and South Forks of the Nooksack River. .... 147

**Table 4.6:** Origin of Spawners in the North/Middle Forks of the Nooksack River (Co-Manager unpublished data). .... 147

**Table 4.7.** Natural origin return per spawner rates for early chinook in the North/Middle Fork of the Nooksack River (Co-Manager unpublished data). .... 149

**Table 4.8.** Origin and replacement rate of early chinook spawners in the South Fork Nooksack River. .... 150

**Table 4.9.** Estimates of the contributions of the native South Fork stock to natural spawning in the South Fork of the Nooksack River, 1999 - 2003. .... 151

**Table 4.10.** Average harvest distribution of Nooksack early chinook, for management years indicated, as percent of total adult equivalent fishery mortality (CTC 2003). .... 152

**Table 4.11.** Current Estimates of Escapements of Salmon Contributing Significant Marine Derived Nutrients to the Nooksack System. .... 152

**Table 5.1:** Habitat targets for Nooksack early chinook freshwater habitats. .... 219

**Table 5.2.** Functional objectives for resource issues under the Forest and Fish Rules. 224

**Table 5.3.** Optimum Values Calculated from the Beverton Holt Productivity Curves for the Nooksack Early Chinook Stocks Generated by EDT Model with Properly Functioning Conditions for Chinook Habitat. .... 248

**Table 5.4.** Results of VRAP runs for the Nooksack spring chinook management unit for each spawner-recruit function. .... 248

**Table 5.6.** Estimates of the Origin of the Early Chinook Stocks Entering the Nooksack River. .... 249

**Table 6.1.** Preliminary Cost Estimates for the Near-Term Actions. .... 278

**Table 6.2.** Preliminary Cost Estimates for Habitat Action #2 10-Year Implementation Scenario ..... 280

**Table 6.3.** Commitments and Conditions for WRIA 1 Near-Term Salmon Recovery Actions ..... 283

**LIST OF FIGURES**

**Figure 1.1.** Geographic regions identified within Puget Sound chinook ESU for evaluation of ESU-wide recovery scenarios..... 5

**Figure 1.2.** Core areas of Puget Sound Recovery Unit of Coastal/Puget Sound Bull Trout Distinct Population Segment. (Source: Puget Sound Shared Strategy). ..... 6

**Figure 1.3.** Water Resource Inventory Area (WRIA) 1..... 11

**Figure 3.1.** Water Resource Inventory Area (WRIA) 1 Subbasin Areas. .... 57

**Figure 3.2.** Current and potential/historic salmonid-bearing streams in WRIA 1. .... 58

**Figure 3.3.** WRIA 1 Streams by Habitat Type..... 59

**Figure 3.4.** Chinook distribution in WRIA 1..... 60

**Figure 3.5.** Native char (bull trout/Dolly Varden) distribution in WRIA 1..... 61

Migratory corridors are very important for bull trout as they repeatedly forage in and migrate through these areas. The degraded conditions of the forks and mainstem downstream from spawning and rearing areas, and lost salmon productivity here, and in other foraging areas, have also contributed to the decline. Thermal impairment of the South Fork is of particular concern. .... 135

**Figure 4.1.** EDT estimates of current and historic habitat potential with respect to Nooksack early chinook adult capacity, adult productivity, and life history diversity.136

**Figure 4.2.** Diagram of interactions among watershed processes, habitat conditions, anthropogenic impacts, and salmonid population viability. .... 137

**Figure 4.3.** Geographic priorities for South Fork Nooksack early chinook using EDT. .... 141

**Figure 4.4.** Geographic priorities North Fork/Middle Fork Nooksack early chinook using EDT..... 142

**Figure 4.5.** Limiting factor priorities for South Fork Nooksack early chinook using EDT. .... 143

**Figure 4.6.** Limiting factor priorities for North Fork/Middle Fork Nooksack early chinook using EDT..... 144

**Figure 4.7.** Total adult equivalent Exploitation rate of Nooksack early chinook for management years 1983 – 2000, estimated by post-season FRAM runs..... 146

**Figure 4.8.** Natural-origin and total natural escapement to the North / Middle Fork of the Nooksack River, and Kendall Creek Hatchery releases three years prior. .... 148

**Figure 4.9.** Spawner-recruit relationships under current, recovered, and historical habitat conditions in the North / Middle Fork of the Nooksack River, as estimated by EDT analysis. .... 150

**Figure 4.10.** The spawner – recruit functions for South Fork Nooksack early chinook under current, recovered, and historic habitat conditions, from the EDT model. .... 150

**Figure 5.1.** Display of Beverton Holt Curves Generated By the EDT Model for North/Middle Fork and South Fork Nooksack Chinook Populations..... 250

**Figure 5.2.** Flow Chart For the Chinook FRAM. .... 251

**Figure 6.1.** Diagram of Adaptive Management Process. .... 277

## **LIST OF APPENDICES**

Appendix A. List of Acronyms.

Appendix B: Near-Term (10-Year) Salmon Recovery Actions.

Appendix C. Technical Background.

Appendix D: WRIA 1 Salmonid Periodicity Chart.

Appendix E: WRIA 1 Salmonid Habitat Restoration Strategy (version 2.4; 2004).