Clallam County

WRIA 19 Multipurpose Water Storage Study

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WRIA 19 MULTIPURPOSE WATER STORAGE STUDY

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WRIA 19 Multipurpose Water Storage Study
TABLE OF CONTENTS

Title *Page No.*

Table of Contents ..... **i**

Executive Summary **ES-1**
Introduction ES-1
Study Area Description ES-1
Water Needs Analysis ES-2
Community Water Systems ES-2
Potential Storage Projects ES-3
Structural Projects ES-3
Nonstructural Projects ES-5
Evaluation and Recommendations ES-6

Chapter 1. Introduction **1-1**
Background 1-1
Water Needs by Subbasin 1-2
Potential Storage Alternatives 1-3
Recommendations and Evaluation 1-3

Chapter 2. Water Needs Analysis **2-1**
Community Water Systems 2-3
Crescent Water Association 2-3
Clallam PUD #1 2-5
Summary 2-8

Chapter 3. Structural Alternatives **3-1**
Types of Structural Projects 3-1
Surface Water Storage 3-1
Natural Floodplain Storage—Restoring Wetlands and Floodplain Connectivity 3-2
Aquifer Storage and Recovery 3-3
Stream Restoration 3-3
Supplemental Water Supply 3-4
Potential Projects in Salt Creek Subbasin 3-4
Surface Water Storage 3-4
Natural Floodplain Storage 3-5
Aquifer Storage and Recovery 3-5
Stream Restoration 3-5
Potential Projects in Lyre River and Lake Crescent Subbasins 3-7
Surface Water Storage 3-7
Stream Restoration 3-8
Potential Projects in Twin Rivers Subbasin 3-8
Natural Floodplain Storage 3-8

Potential Projects in Deep Creek subbasin 3-10
Stream Restoration 3-10
Potential Projects in Pysht River Subbasin 3-10
Natural Floodplain Storage 3-10
Potential Projects in Clallam River Subbasin 3-12
Surface Water Storage 3-12
Aquifer Storage and Recovery 3-12
Supplemental Water Supply 3-12
Potential Projects in Hoko River Subbasin 3-13
Surface Water Storage 3-13
Stream Restoration 3-14
Potential Projects in Sekiu River Subbasin 3-14

Chapter 4. Nonstructural Alternatives 4-1
WRIA-Wide Nonstructural Solutions 4-1
Promote Maintenance of Lands in Forest Management 4-1
Encourage Low-Impact Development 4-2
Promote Water Conservation Policies/Projects 4-3
Re-establish Beaver Populations 4-3
Forest Practices Information and Communication Forums 4-5
Implement Road Maintenance and Abandonment Programs 4-5
Complete a Comprehensive Wetland Inventory 4-6
Complete a Stream Walk Inventory 4-6
Provide Mitigation for New Water Rights 4-7
Location-Specific Nonstructural Solutions 4-7
Salt Creek Subbasin 4-7
Lyre River and Lake Crescent Subbasins 4-7
Twin Rivers Subbasin 4-8
Pysht River Subbasin 4-8
Hoko River Subbasin 4-8

Chapter 5. Evaluation and Recommendations 5-1
Evaluation Process 5-1
Initial Screening 5-1
Assessment of Screened Alternatives 5-3
Recommendations 5-6
Action Plan 5-9
Summary 5-10

References R-1

LIST OF TABLES

No.	Title	Page No.
ES-1	Water Rights as a Percentage of Recently Recorded Low Flows	ES-2
ES-2	Potential Structural Storage Projects by Subbasin	ES-4
ES-3	Recommended Alternatives	ES-7
1-1	Focus for Water Storage Alternatives	1-2
2-1	Summary of Water Rights by Subbasin	2-2
2-2	Water Rights as a Percentage of Recently Recorded Low Flows	2-2
2-3	Clallam Bay/Sekiu Water System Water Right Inventory	2-7
5-1	Results of Initial Screening of Alternatives	5-2
5-2	Estimated Project Costs for Screened Alternatives	5-4
5-3	Ratings for Screened Structural and Location-Specific Nonstructural Alternatives	5-5
5-4	Recommended Alternatives	5-7
5-5	Considerations for Developing an Action Plan for Recommended Alternatives	5-11

LIST OF FIGURES

No.	Title	Page No.
2-1	Crescent Water Association Service Area	2-4
2-2	Clallam Bay/Sekiu Service Area	2-6
2-3	Island View Service Area	2-8
3-1	Camp Hayden Road Abandonment Project	3-6
3-2	Potential Restoration Project Sites in Twin Rivers Subbasin	3-9
3-3	Potential Restoration Project Sites in Pysht River Subbasin	3-11
3-4	Potential Restoration Project Sites in Hoko River Subbasin	3-15

EXECUTIVE SUMMARY

INTRODUCTION

The *WRIA 19 Multipurpose Water Storage Study* was conducted by the Tetra Tech consulting team for Clallam County on behalf of the Planning Unit for Water Resource Inventory Area (WRIA) 19, the Hoko-Lyre Watershed. The study was done to support the Planning Unit in developing a Watershed Plan for the WRIA 19 under Washington's Watershed Management Act. It focused on evaluating water storage possibilities that achieve one or both of the following benefits:

- Provide water for future consumptive water needs, primarily domestic needs.
- Meet instream flow needs through base flow restoration.

The study evaluated domestic and commercial water needs for existing and future conditions. Instream flows were not assessed for the water storage study; a separate instream flow analysis was conducted as part of the *WRIA 19 Watershed Plan* and is included in the Plan.

STUDY AREA DESCRIPTION

WRIA 19, which covers the northern portion of Washington's Olympic Peninsula, consists of nine major subbasins:

- Salt Creek Subbasin
- Lyre River Subbasin
- Lake Crescent Subbasin
- Twin Rivers Subbasin
- Deep Creek Subbasin
- Pysht River Subbasin
- Clallam River Subbasin
- Hoko River Subbasin
- Sekiu River Subbasin

Because of the low level of existing and expected future development in the Lake Crescent Subbasin, analysis of that subbasin in the water storage study is generally included in the analysis of the Lyre River Subbasin; Lake Crescent is the water source for the Lyre River.

WRIA 19 receives more than sufficient rainfall to meet instream flow requirements and water demand during the winter. In the summer, however, water demand is at a peak while rainfall is at a minimum, and base flows in streams and rivers can drop significantly. Wintertime rainfall recharges the watershed's aquifers, which effectively store the water and release it in the drier months. This groundwater base flow accounts for most of the stream flow during the summer.

Much of WRIA 19 is undeveloped. Given the watershed's small population (about 4,500 residents) consumptive water demand does not place much burden on water resources. Based on Clallam County population growth projections and current zoning, population growth will occur in two parts of the watershed—the Salt and Lyre River Subbasins, and the Clallam Bay region. Even if population growth exceeds forecasts, consumptive needs could still be met with existing water rights.

In WRIA 19, 76 percent of the land is zoned for commercial forestry, which can have significant effects on natural hydrologic processes. Many of the projects evaluated in this study focus on preserving or restoring natural hydrologic function.

WATER NEEDS ANALYSIS

In WRIA 19, the largest consumptive water rights are held by municipal water purveyors in the Lyre River, Clallam River, and Hoko River Subbasins. Table ES-1 compares total instantaneous consumptive water rights to stream flows measured in August 2004 as part of the instream flow study. Consumptive uses in the Salt Creek and the Clallam River Subbasins, the two subbasins with the highest population, appear to be significant relative to summer base flows. Surface water withdrawals for the two largest water purveyors—the Crescent Water Association (CWA) and Clallam PUD #1—are from the Lyre and Hoko Rivers, respectively. Consumptive water use in the Pysht, Sekiu, Salt, and Clallam River Subbasins may also be significant relative to base flows, though most users likely return water through septic tank-leach field systems in those basins.

TABLE ES-1.
WATER RIGHTS AS A PERCENTAGE OF RECENTLY RECORDED LOW FLOWS

Subbasin	Consumptive Instantaneous Water Rights (cubic feet/second)	Measured Flows, August 2004 (cubic feet/second)	Water Rights as a Percentage of Low Flows
Salt Creek	6.20	0.8	775.0%
Lyre River	5.40	51.0	10.6%
Twin Rivers	0.16	2.6	6.2%
Deep Creek	0.04	3.0	1.3%
Pysht River	0.40	2.1	19.0%
Clallam River	2.50	2.5	100.0%
Hoko River	1.70	13.0	13.1%
Sekiu River	0.70	3.7	18.9%

COMMUNITY WATER SYSTEMS

The following are the major active community water systems in WRIA 19:

- **Crescent Water Association**—The CWA is a private, non-profit Washington corporation with over 800 members, including residential and commercial accounts in the Lyre River and Salt Creek Subbasins. The water source for its supply is the Lyre River. Current system storage consists of approximately 375,000 gallons in four reservoirs. It is estimated that the current water system configuration will support 1,104 connections. With completion of the two additional storage tanks in 2005, the system is projected to support 1,440 connections. This level is expected to meet system demand for approximately 20 years.
- **Clallam Bay PUD #1**— Clallam PUD #1 operates nine water districts in Clallam County, two of them in WRIA 19:
  - **Clallam Bay/Sekiu District**—The Clallam Bay/Sekiu District serves 1,272 equivalent residential units (ERUs) in or near the Clallam Bay/Sekiu urban growth area, including the Clallam Bay Correctional Facility, which accounts for 740 ERUs. The system uses groundwater from the Hoko well field. The system currently has adequate source capacity to service

2,316 ERUs. The District currently operates three storage reservoirs with a total capacity of 220,000 gallons. The Clallam Bay Correctional Facility also operates three reservoirs that are supplied by Clallam Bay/Sekiu, totaling 1.3 millions gallons of storage.

– **Island View LUD**—The Island View Water System serves 38 ERUs in a rural residential development along SR 112. The District's source intake on Olsen Creek and 50,000-gallon storage reservoir can satisfy projected demand through 2021.

- **Four Seasons Park**—A water system owned and operated by a homeowners' association, with 91 connections
- **San Juan Vista**—A small water system with 30 connections.

The water system facilities throughout WRIA 19 appear to be adequate for the foreseeable future. Demand for water in areas not currently serviced by a major water purveyor has not been examined.

POTENTIAL STORAGE PROJECTS

The water storage study assessed a range of storage-related projects in two categories—"structural" alternatives that involve physical modifications at a specific site; and "nonstructural" alternatives that derive their benefit from policies, studies or other activities that involve no physical alteration or construction.

Structural Projects

Structural projects are grouped under five broad types of projects:

- **Surface water storage**—There are no existing surface water reservoirs in WRIA 19. New reservoirs can be on-channel or off-channel. Given the lack of suitable dam sites in the watershed and the environmental impact and expense of on-channel projects, on-channel reservoirs are not recommended. For off-channel storage, the potential surface water demand in WRIA 19 is small enough to use storage tanks or constructed reservoirs instead of dams.
- **Natural floodplain storage (wetland restoration and floodplain connectivity)**—Wetland restoration projects include reconnecting overbank areas to the floodplain, inundating historical wetland areas, and increasing the water depth in existing wetlands. Such projects recharge the groundwater. They contribute only a small amount of storage compared to a reservoir, but they provide additional benefits including flood control, wildlife habitat, and water quality benefits.
- **Aquifer storage and recovery**—Aquifer Storage and Recovery (ASR) is a process by which an aquifer is recharged with excess runoff or groundwater that is stored in the aquifer until it is needed at a later time.
- **Stream restoration**—Stream restoration projects address streams that are suffering from channel incision and degraded riparian conditions and are no longer connected to natural floodplain storage. The general concept is to restore stream base levels in order to slow winter flows and promote more channel/floodplain interaction. Like wetland restoration projects, stream restoration projects provide water storage as an indirect benefit.

- **Supplemental water supply**—Only one option was assessed for providing a water supply from other sources to supplement the supply available from surface water: the use of treated, reclaimed wastewater.

Table ES-2 summarizes the identified potential structural projects by subbasin.

TABLE ES-2.
POTENTIAL STRUCTURAL STORAGE PROJECTS BY SUBBASIN

Project	Project Type: Surface Water Storage	Natural Floodplain Storage	Aquifer Storage & Recovery	Stream Restoration	Supplemental Water Supply
Salt Creek Subbasin					
Projects to Control Runoff	X				
Abandon Camp Hayden Spur Road		X			
Aquifer Storage and Recover			X		
Treatment of Channel Incision at RM 2.0 – 4.0				X	
Lyre River/Lake Crescent Subbasins					
Water Supply Storage	X				
Restore the Lowest Mile of Lyre River				X	
Twin Rivers Subbasin					
Logjams/Wetland Restoration (seven locations)		X			
Deep Creek Subbasin					
Remedy Channel Incision				X	
Pysht River Subbasin					
Restore Wetlands and Floodplain Connectivity (four locations)		X			
Clallam River Subbasin					
Projects to Control Runoff	X				
Aquifer Storage and Recover			X		
Promote the Use of Reclaimed Water					X
Hoko River Subbasin					
Water Supply Storage	X				
Hoko River Habitat Restoration (5900 Road near Ellis Creek)				X	
Hoko River Riparian Restoration (Lower Hoko River on Cowan Ranch)				X	

Nonstructural Projects

Nonstructural alternatives are policy-type solutions rather than constructed physical projects. These alternatives may not immediately or directly create water storage, but they help restore and maintain base flows. For this study, nonstructural projects were identified that would apply to the entire watershed or to specific locations. The WRIA-wide nonstructural projects are as follows:

- Promote maintenance of lands in forest management, rather than alternative land uses.
- Encourage low-impact development.
- Promote water conservation policies/projects.
- Re-establish beaver populations.
- Provide forest practices information and communication forums.
- Implement road maintenance and abandonment programs (including for areas outside of commercial forests).
- Complete a comprehensive wetland inventory.
- Complete a stream walk inventory.
- Provide mitigation for new water rights.

The following potential nonstructural approaches are targeted to only a portion of the watershed:

- **Salt Creek Subbasin; Stop Unauthorized Water Withdrawals**—Unauthorized water withdrawals are a problem in the Salt Creek Subbasin. This project would commission a survey to identify and estimate the number of illegal water connections in the system. Follow-up actions by the Washington Department of Ecology would curtail any unauthorized diversions.
- **Lyre River and Lake Crescent Subbasins; Increase Efficiency of Existing Water System**—The CWA water system experiences water losses of approximately 15 percent. CWA is currently updating auditing procedures as well as adding additional meters and replacing existing water meters in order to better identify loss zones and reduce losses.
- **Lyre River and Lake Crescent Subbasins; Coordination between Lyre River and Lake Crescent Subbasins**—Lake Crescent forms a major part of the headwaters for the Lyre River, and as such any management actions on Lake Crescent impact the Lyre River. Any future plans for Lake Crescent that could have downstream impacts should include coordination and stakeholder involvement from the Lyre River Subbasin.
- **Twin Rivers Subbasin; Source Protection Study**—Past observations indicate that the Twin Rivers are able to sustain base flow longer than the other major water courses in WRIA 19. This is due largely to the fact that the headwaters of the rivers are fed by groundwater springs. To preserve the springs from contamination or destruction, the location of the springs as well as the aquifer recharge zone should be identified and protected.
- **Pysht River Subbasin; Bank Erosion and Flooding Study**—The Washington State Department of Transportation is in the process of conducting a reach analysis along select reaches of the Hoko, Clallam and Pysht Rivers to assess erosion and

flood hazards to SR 112. The analysis will identify potential problem sites and provide conceptual solutions to protect the highway from erosion and flooding. Particularly where the highway is located close to the river, this study should consider acquisition of land on the opposite bank of the river for channel migration and floodplain storage.

- **Hoko River Subbasin; Increase Efficiency of Existing Water System**—Improving the efficiency of the Clallam Bay/Sekiu water system could reduce water demand on the Hoko River. The water district is currently addressing conservation methods as well as implementing measures to reduce water losses.

EVALUATION AND RECOMMENDATIONS

Based on an initial qualitative assessment, water surface storage and ASR projects were determined to be unsuitable and were eliminated from further evaluation; no cost estimates or conceptual project designs were developed for these projects. Because the nonstructural projects represent good watershed management policy, all of them are recommended; therefore, no further evaluation or comparison was done. One nonstructural project, the bank erosion and flooding study in the Pysht subbasin, is currently in progress and is therefore not evaluated or included in the recommendations. Table ES-3 summarizes the recommended storage projects.

TABLE ES-3.
RECOMMENDED ALTERNATIVES

Project	Project Type[a]	Estimated Cost
Salt Creek Subbasin		
Abandon Camp Hayden Spur Road	NFS	$1,000,000
Stop Unauthorized Water Withdrawals	LS	$85,000
Lyre River/Lake Crescent Subbasins		
Increase Efficiency of Existing Water System	LS	$200,000
Coordination Between Lyre River and Lake Crescent Subbasins	LS	$40,000
Twin Rivers Subbasin		
Source Protection Study	LS	$100,000
Clallam River		
Reclaimed Water	SUP	$300,000
WRIA-Wide		
Promote Maintenance of Lands in Forest Management	WW	$200,000
Encourage Low-Impact Development	WW	$150,000
Promote Water Conservation Policies/Projects	WW	$150,000
Re-establish Beaver Populations	WW	$150,000
Forest Practices Information and Communication Forums	WW	$150,000
Implement Road Maintenance and Abandonment Programs	WW	$300,000
Complete a Comprehensive Wetland Inventory	WW	$300,000
Complete a Stream Walk Inventory	WW	$150,000
Mitigation for New Water Rights	WW	$200,000

a. NFS = Structural natural floodplain storage; WW= Nonstructural WRIA-wide; LS = Nonstructural location-specific; SUP = Supplemental water supply

CHAPTER 1.
INTRODUCTION

BACKGROUND

This report documents the results of a multipurpose water storage analysis conducted by the Tetra Tech consulting team for Clallam County on behalf of the Planning Unit for Water Resource Inventory Area (WRIA) 19, the Hoko-Lyre Watershed. This study was done to support the Planning Unit in developing a Watershed Plan for the WRIA 19 under Washington's Watershed Management Act (Revised Code of Washington (RCW) 90.82), also known as a "2514 Watershed Plan." This report summarizes a survey-level study to examine multipurpose water storage options that could benefit instream and out-of-stream water needs.

The goal of this assessment was to identify feasible water storage alternatives that could benefit current and future water needs in WRIA 19. Specific objectives include the following:

- Determine the water storage infrastructure needs of public and private water systems.
- Identify and evaluate storage projects that could create or enhance stream flow during the summer/early fall low-flow period.
- Identify storage projects that will assist in meeting future out-of-stream water demands without impairing the natural functioning of WRIA 19 water resources and their dependent ecosystems.
- Consider whether candidate storage projects could also provide flood management benefits.

Like most watersheds in Western Washington, WRIA 19 receives more than sufficient rainfall to meet both instream flow requirements and water demands during the winter. In the summer, however, water demand is at a peak while rainfall is at a minimum, and summer base flows in streams and rivers can drop to levels that hinder salmonid production as well as reduce water quality (Smith et al., 2001).

Because most rivers in the watershed are not fed by melting mountain snow, groundwater plays an important function. Wintertime rainfall recharges the watershed's aquifers, which effectively store the water and release it in the drier months. This groundwater release is defined as base flow, accounting for most of the stream flow during the summer.

Much of WRIA 19 is undeveloped. Given the watershed's relatively small population (about 4,500 residents), consumptive water demand does not place as much of a burden on water resources (except in specific locations) as in other more populated watersheds within the state. Even if population growth exceeds projected forecasts, consumptive needs could still be met with existing water rights. Increased withdrawals to meet population growth could have an undesirable impact, especially if new withdrawals occur on the small streams of the watershed.

Commercial forestry dominates the landscape in WRIA 19, with 76 percent of the land zoned for commercial forestry. Forest practices, in particular clear-cut logging and road building, produce a dramatic change to the natural landscape that can have significant effects on natural hydrologic

processes, including increased runoff, increased peak flows, and decreased infiltration (Rice et al., 2001). The increased peak flows can lead to channel incision, which lowers the base elevation of the stream, disconnecting it from its natural floodplain storage and lowering the groundwater table. The extent of these impacts on water storage and summer base flows in the watershed is undetermined. However, because of the dominance of commercial forestry in WRIA 19, many of the projects evaluated in this study focus on preserving/restoring natural hydrologic function.

WATER NEEDS BY SUBBASIN

This study focused on evaluating water storage possibilities that achieve one or both of the following benefits:

- Provide water for future consumptive water needs, primarily human domestic needs.
- Meet instream flow needs through base flow restoration.

WRIA 19 is divided into multiple subbasins, and the need for these two types of benefits varies by subbasin (see Table 1-1).

TABLE 1-1.
FOCUS FOR WATER STORAGE ALTERNATIVES

Subbasin	Human Domestic Consumptive Water Needs	Base Flow Restoration
Salt Creek	✓	✓
Lyre River/Crescent Lake	✓	✓
East and West Twin Rivers		✓
Deep Creek		✓
Pysht River		✓
Clallam River	✓	✓
Hoko River	✓	✓
Sekiu River		✓

Based on Clallam County population growth projections and current zoning, population growth will occur in two parts of the watershed—the Salt and Lyre River Subbasins, and the Clallam Bay region (located in the Clallam River and Hoko River Subbasins). Elsewhere, population growth is expected to be less concentrated. Because of this, alternatives for using water storage to assist in providing water for current and future consumptive water needs were evaluated in the Salt, Lyre/Crescent, Clallam, and Hoko Subbasins (because of the sparse level of development in the Lake Crescent Subbasin, it is combined with the Lyre River Subbasin in the analyses and discussions in this report).

Water storage alternatives to restore base flows were evaluated in all subbasins. These alternatives are typically actions that work to remedy disturbed watershed conditions—such as incised channels (Salt Creek, Deep Creek, and Pysht River), lack of natural floodplain storage (all subbasins), enlarged channels (all subbasins), and lack of riparian cover (all subbasins)—and restore natural conditions to the watershed.

POTENTIAL STORAGE ALTERNATIVES

This survey-level study assesses a range of storage-related projects that warrant further consideration and was based on a review of available existing information. No new analyses were conducted for this report, so the level of detail for projects identified in this report depended on the information available. In some instances, projects would require considerably more investigation before a final determination could be made as to their feasibility.

Storage alternatives in two categories were evaluated—"structural" alternatives that involve physical modifications at a specific site; and "nonstructural" alternatives that derive their benefit from policies, studies or other activities that involve no physical alteration or construction. Nonstructural alternatives generally benefit a broader area than structural alternatives; most could be applied WRIA-wide, although some are specific to one or two individual subbasins.

Five broad types of structural alternatives were considered in this analysis:

- Surface water storage
- Natural floodplain storage (through wetland restoration or floodplain connectivity)
- Aquifer storage and recovery
- Stream restoration
- Supplemental water supply.

Nonstructural alternatives are policy-type solutions rather than constructed physical projects. These alternatives may not immediately or directly create water storage, but they help restore and maintain base flows. They include the following:

- Promote maintenance of lands in forest management, rather than alternative land uses
- Encourage low-impact development.
- Promote water conservation policies/projects.
- Re-establish beaver populations.
- Provide forest practices information and communication forums.
- Implement road maintenance and abandonment programs (including for areas outside of commercial forests).
- Complete a comprehensive wetland inventory.
- Complete a stream walk inventory.
- Provide mitigation for new water rights.

Other nonstructural approaches that are targeted to only a portion of the watershed were considered as appropriate in an assessment of each subbasin for this study.

RECOMMENDATIONS AND EVALUATION

Given WRIA 19's low population density and land use dominated by commercial logging, programmatic and restoration solutions are best suited to address current and future water storage needs in the watershed. Projects were selected for evaluation based on the following criteria:

- Ease of implementation
- Water storage ability
- Potential cost
- Potential benefits/detriments
- Potential fish benefit
- Habitat potential.

Priority was given to projects in basins that have been identified with a high need for water for instream flow or for consumptive uses.

CHAPTER 2.
WATER NEEDS ANALYSIS

The most important information needed in order to establish storage projects is an analysis of the watershed's overall water requirements for the future and where the water is needed. No definitive conclusions about water storage needs can be reached until a consensus is reached on instream flow needs and projected future consumptive requirements. This chapter reviews existing information regarding expected water needs and current deficiencies.

Domestic and commercial water needs are summarized below for existing and future conditions. Instream flows are not assessed in this report; a separate instream flow analysis was conducted as part of the WRIA 19 Watershed Plan and is included in the Plan. At the time of this report, limited flow data and observations have indicated that summer base flows are often low enough to endanger fish throughout WRIA 19.

Consumptive water uses can have a significant effect on stream flows. Table 2-1 summarizes water rights (legal rights to withdraw water) by subbasin in WRIA 19 and identifies large individual water rights. It should be noted that some of these large water rights are designated for non-consumptive purposes such as power generation or fish propagation. These uses typically return most of the diverted water back to the stream, although the return point may be some distance downstream of the diversion, leaving a section of stream with reduced flow. In WRIA 19, the largest consumptive water rights are held by municipal water purveyors in the Lyre, Clallam, and Hoko Subbasins.

The potential impact of consumptive water withdrawals on stream flows in each subbasin is illustrated in Table 2-2, which compares total instantaneous consumptive water rights to stream flows measured in August 2004. These stream flow measurements were conducted as part of the instream flow study done in conjunction with the WRIA 19 Watershed Plan and do not necessarily represent the lowest flow (base flow); they are simply spot measurements taken throughout the watershed from August 18-21, 2004. The results illustrated in Table 2-2 would not change significantly based on normal flow variations. It should be noted that not all of the water rights in each subbasin are direct water withdrawals from the main water course or from aquifers directly connected to the main water course. Groundwater withdrawals are likely to have a delayed impact on stream flow in the subbasin. However, the data still give a useful overview of potential impacts of consumptive use.

Consumptive uses in the Salt Creek and the Clallam River Subbasins appear to be significant relative to summer base flows. The Salt Creek and Clallam Subbasins are the two subbasins with the highest population. The two largest water purveyors—the Crescent Water Association (CWA) and Clallam PUD #1—have service areas in the Salt Creek and Clallam River Subbasins, respectively. Surface water withdrawals for these entities are from the Lyre and Hoko Rivers, respectively. An overview of their current and future water requirements is provided in the next section. Consumptive water use in the Pysht, Sekiu, Salt, and Clallam River Subbasins may also be significant relative to base flows, though most users likely return water through septic tank-leach field systems in those basins.

TABLE 2-1.
SUMMARY OF WATER RIGHTS BY SUBBASIN

Subbasin	Population	Total Number of Rights	Total Allowable Instantaneous Withdrawal Rate (cfs)	Large Individual Rights
Salt Creek	2,319	255	7.3	• A 0.6-cfs right for power • A 0.5-cfs right for fish propagation • A 0.1-cfs right for domestic-multiple
Lyre River	184	24	5.5	• A 5.01-cfs right for domestic-multiple • A 0.11-cfs right for fish propagation and domestic-single
Lake Crescent	65	128	4.2	• A 1.0-cfs right for power and domestic-single • A 0.33-cfs right for power generation
Twin Rivers	29	9	0.16	No large rights
Deep Creek	1	2	0.04	No large rights
Pysht River	48	15	0.4	No large rights
Clallam River	1,567	35	2.5	• A 1.0-cfs right for municipal • A 0.62-cfs right for domestic-multiple • A 0.22-cfs right for domestic-multiple
Hoko River	215	23	6.9	• Two fish-propagation rights totaling 5.22 cfs • Three domestic-multiple rights totaling 1.29 cfs
Sekiu River	113	20	0.7	• A 0.3-cfs right for domestic-multiple • A 0.2-cfs right for domestic-multiple

cfs = cubic feet per second

TABLE 2-2.
WATER RIGHTS AS A PERCENTAGE OF RECENTLY RECORDED LOW FLOWS

Subbasin	Consumptive Instantaneous Water Rights (cfs)	Measured Flows, August 2004 (cfs)	Water Rights as a Percentage of Low Flows
Salt Creek	6.20	0.8	775.0%
Lyre River	5.40	51.0	10.6%
Twin Rivers	0.16	2.6	6.2%
Deep Creek	0.04	3.0	1.3%
Pysht River	0.40	2.1	19.0%
Clallam River	2.50	2.5	100.0%
Hoko River	1.70	13.0	13.1%
Sekiu River	0.70	3.7	18.9%

COMMUNITY WATER SYSTEMS

Active community water systems in WRIA 19 include the following:

- The Crescent Water Association, a private, non-profit Washington corporation with over 800 members, including residential and commercial accounts
- Clallam Bay PUD #1, which operates the Clallam Bay/Sekiu Water District and Island View LUD, with a total of 828 connections
- Four Seasons Park, a water system owned and operated by a homeowners' association, with 91 connections
- San Juan Vista, with 30 connections.

There are a number of "transient, non-community" systems serving recreation parks, camps, and federal and municipal park facilities. There are also a number of investor-owned utilities serving a limited number of connections. A description of the main water system purveyors is given below.

Crescent Water Association

The Crescent Water Association is a publicly owned, non-profit water system. With the exception of some mixed/commercial land in the Joyce area, the CWA serves single-family residences in the Lyre River and Salt Creek Subbasins (see Figure 2-1). The water source for its supply is the Lyre River.

There are currently no plans for expansion of the CWA service area. Current expansion forecasts are for infill of the existing service area. The current growth rate is estimated to be 2.5 percent per year. There were 588 active connections in 1990 and approximately 840 in 2004. With the exception of the urban growth area (UGA) around Joyce, the predominant zoning in the service area is rural residential. Given the low density of the zoning, a 2.5 percent annual growth rate appears to assume rapid infill of the service area and is consistent with the rapid growth in the eastern part of Clallam County.

The Lyre River is the only source for the system. The intake is located approximately 1 mile downstream of Lake Crescent. Under normal conditions, the capacity of the pump station at the outtake is approximately 300 gallons per minute (gpm). There are currently two pumps at the pump station and station controls could be modified to allow both pumps to run in parallel, thus expanding the peak capacity of the system. A filter plant came on-line in September 2004, in accordance with the federal Surface Water Treatment Rule.

Current system storage consists of approximately 375,000 gallons in four reservoirs. Two of the reservoirs are located on Holly Hill, one at the Lyre River, and one at the "Spring" site. Two additional storage reservoirs are expected to come on line in 2005, providing approximately 250,000 gallons of additional storage.

It is estimated that the current water system configuration will support 1,104 connections. With completion of the two additional storage tanks in 2005, the system is projected to support 1,440 connections. This level is expected to meet system demand for approximately 20 years (Palzer, 2005).

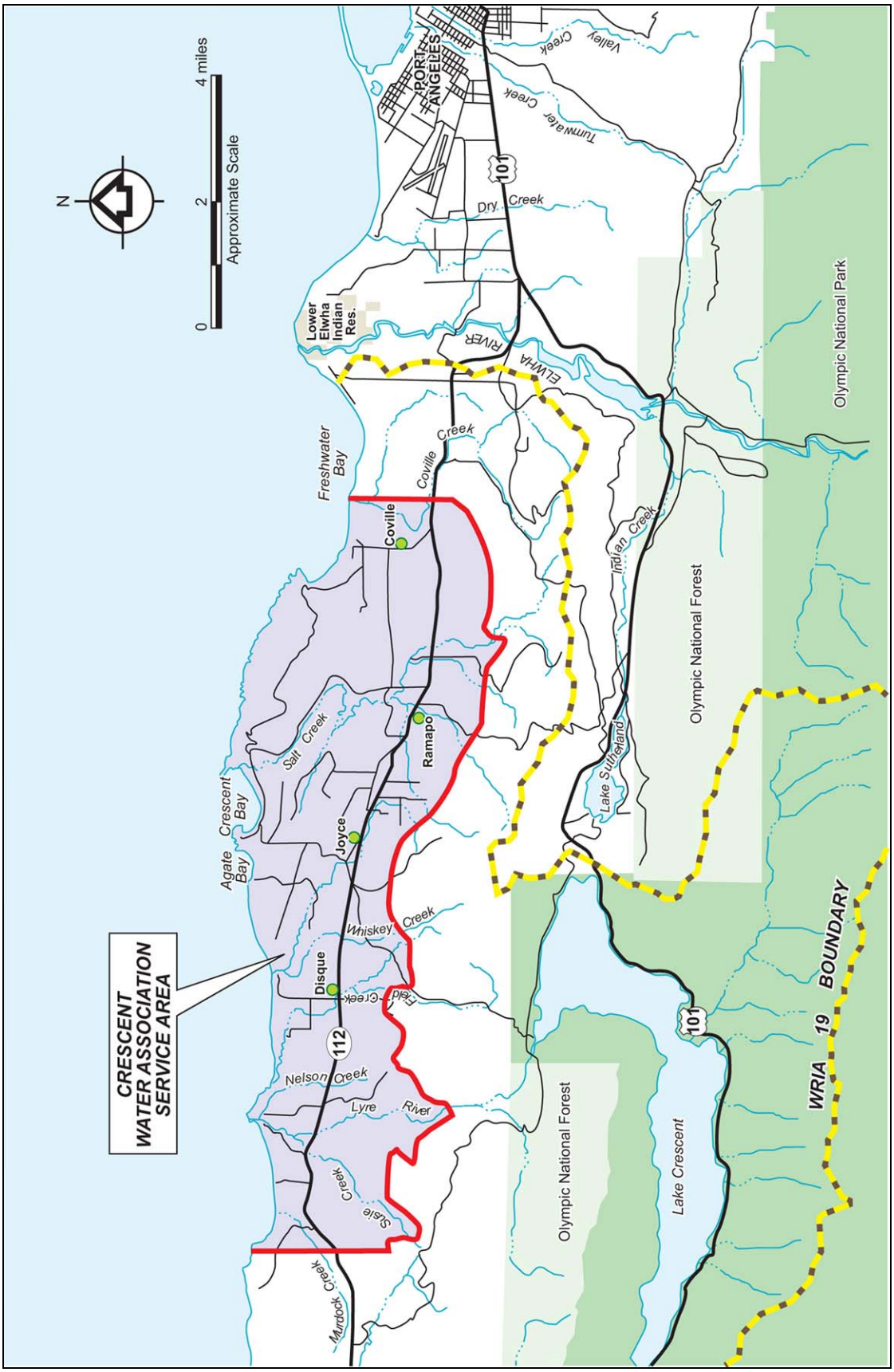

Figure 2-1. Crescent Water Association Service Area

According to the CWA, the water system experiences water losses of approximately 15 percent. When unaccounted water use reaches 20 percent of the total water outtake, state law requires that the purveyor's water system plan address ways to increase efficiency. CWA is currently updating auditing procedures as well as adding additional meters and replacing existing water meters in order to better identify loss zones and reduce losses.

The CWA currently holds water rights for a maximum instantaneous withdrawal rate of 2,250 gpm, with a yearly volume maximum of 672 acre-feet. Current estimates indicate that the CWA is using approximately 56 percent of its allotted water right. Growth projections indicate that 96 percent of the water right will be used within 20 years.

Clallam PUD #1

Clallam PUD #1 operates nine water districts in Clallam County. Of these, the Clallam Bay/Sekiu District and the Island View LUD are the only districts in WRIA 19. The PUD also provides water to the Clallam Bay Correctional Facility – which is considered part of the Clallam Bay/Sekiu District. The PUD provides water for 1,600 equivalent residential units (ERUs) in WRIA 19.

Clallam Bay/Sekiu District

The Clallam Bay/Sekiu Water District is in western Clallam County approximately 50 miles west of Port Angeles. The existing service area boundary for the district is shown in Figure 2-2. The system currently serves 1,272 ERUs, including the Clallam Bay Correctional Facility, which accounts for 740 ERUs. The water district currently serves the entire Clallam Bay/Sekiu UGA and a few customers outside the UGA. Current zoning in the existing service area is commercial, industrial (Clallam Bay Correctional Facility), urban residential and rural residential.

The system currently has adequate source capacity to service 2,316 ERUs and existing water rights to service 2,134 ERUs. Clallam County PUD #1 projects that current water rights and source capacity are sufficient for at least the next 20 years. Growth is projected to occur at a 1-percent rate. Expansion of the Clallam Bay Correctional Facility is not included in the growth estimate since there are no plans to expand the facility in the next 20 years (Economic and Engineering Services, 2003). The current service area could expand within the next six years if the UGA boundaries are adjusted or if non-UGA areas request water service. Expansion of the UGA in Clallam Bay/Sekiu would be problematic due to a lack of existing infrastructure (Economic and Engineering Services, 2003). As a result, expansion of the existing service area boundaries is not anticipated in the near future.

System efficiency shows room for improvement, which could expand the capacity of the water system. Current loss estimates vary from 14 to 24 percent, with an average loss of approximately 20 percent (Kitz, 2005).

The system currently relies solely on groundwater from the Hoko well field, which has an estimated capacity of 600 gpm. The well field is located in the alluvium of the Hoko River and would therefore be hydraulically connected to the river. This means that summertime withdrawals from the well field likely have an impact on instream flows.

According to its Water Plan, the Clallam Bay/Sekiu District holds two active water rights, shown in Table 2-3. Certificate 5488-A supercedes Certificate 7422. The maximum annual volume allowed for withdrawal from the two certificates is 440 acre-feet.

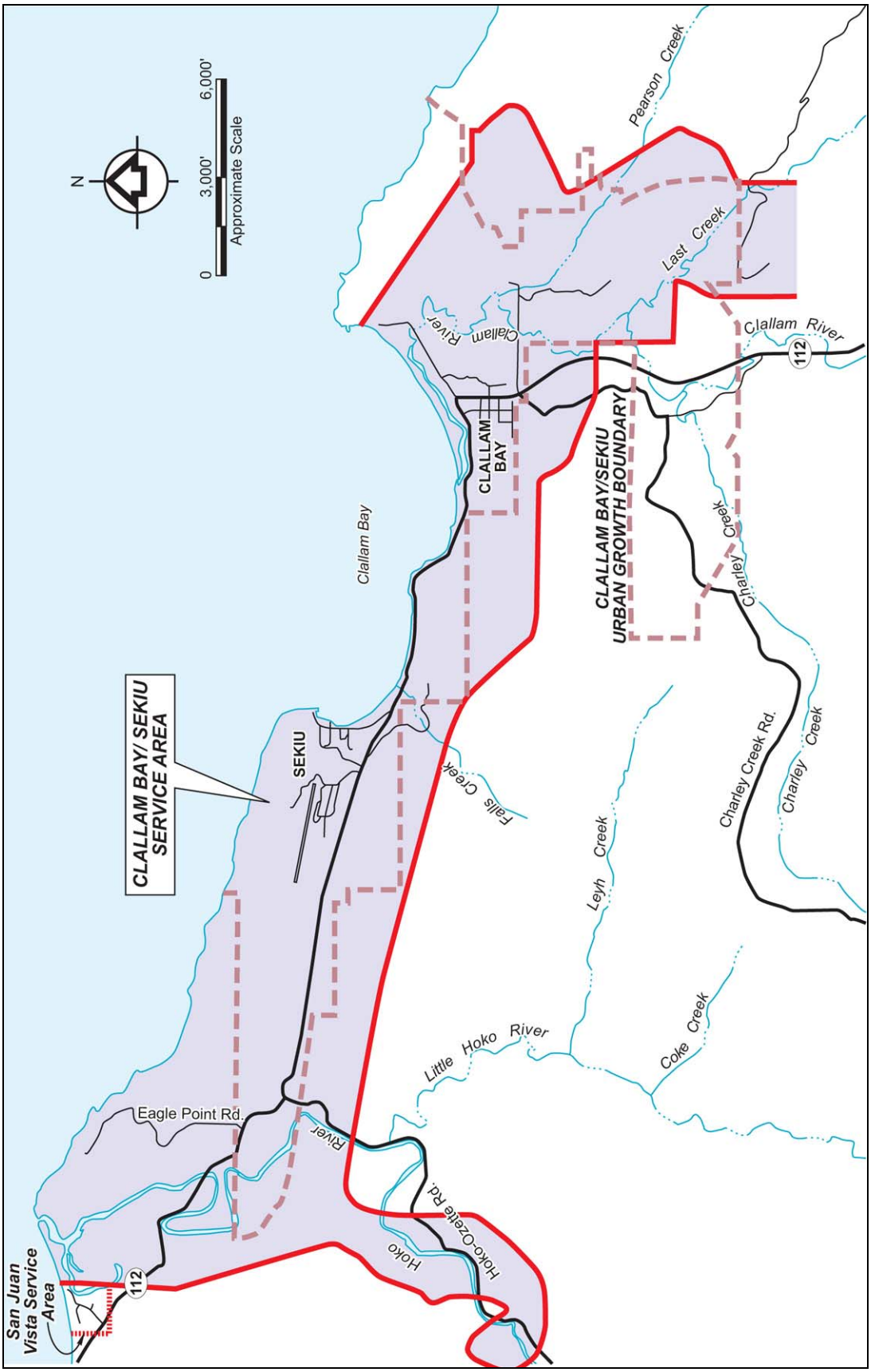

Figure 2-2. Clallam Bay/Sekiu Service Area

TABLE 2-3.
CLALLAM BAY/SEKIU WATER SYSTEM WATER RIGHT INVENTORY

Source Name	Water Right or Claim No.	Name of Right Holder	Priority Date	Allowable Instantaneous Withdrawal (cfs)	Allowable Annual Withdrawal (acre-feet)	Primary or Supplemental
Hoko Well Field	GWC 5488-A	PUD	4/30/1964	1.25	400	Supplemental
Unnamed Clallam River Tributary	SWC 7422	PUD	7/8/1958	1.00	Not Specified	Primary

The Clallam Bay/Sekiu District currently operates three storage reservoirs with a total capacity of 220,000 gallons. The Clallam Bay Correctional Facility also operates three reservoirs that are supplied by Clallam Bay/Sekiu, totaling 1.3 millions gallons of storage.

Island View Water System

The Island View Water System is located in western Clallam County, approximately 10 miles west of Sekiu. Island View serves a rural residential development located along SR 112. The service area for Island View is shown in Figure 2-3. The system currently serves 38 ERUs.

Island View's source intake is on Olsen Creek, approximately 1,200 feet from the creek's mouth. This intake pump currently has peak capacity of 20 gpm.

According to the Water System Plan, current sources can satisfy projected demands through 2021. Island View does not serve any customers within a designated UGA. Current zoning in the area is exclusively Rural Residential. The number of ERUs served by the system is expected to increase to 47 by 2021, based on an anticipated growth rate of 1 percent. Island View currently operates a 50,000-gallon storage reservoir. Existing storage is projected to satisfy demand through 2021, based on current projected growth rates.

According to Mike Kitz, water and wastewater superintendent, losses in the Island View system range from 3 to 16 percent, with an average loss rate of 12 percent. Increasing the efficiency of the system could result in water savings and reduce the demand on Olsen Creek.

The Island View system has one water right, on Olsen Creek, for an instantaneous withdrawal of up to 0.2 cubic feet per second (cfs) and a maximum annual volume of 40 acre-feet; the instantaneous withdrawal is limited to half of the stream flow at the point of diversion at all times. The district's Water Plan lists an additional water right on Pierson Creek for 0.03 cfs. The owner of this water right is listed as Crown Zellerbach, but Island View has submitted a claim of 0.03 cfs for use on the same property.

Based on the information contained in the Water Plan, Island View does not have a serious impact on flows in Olsen Creek and appears to be a low priority system for water storage projects.

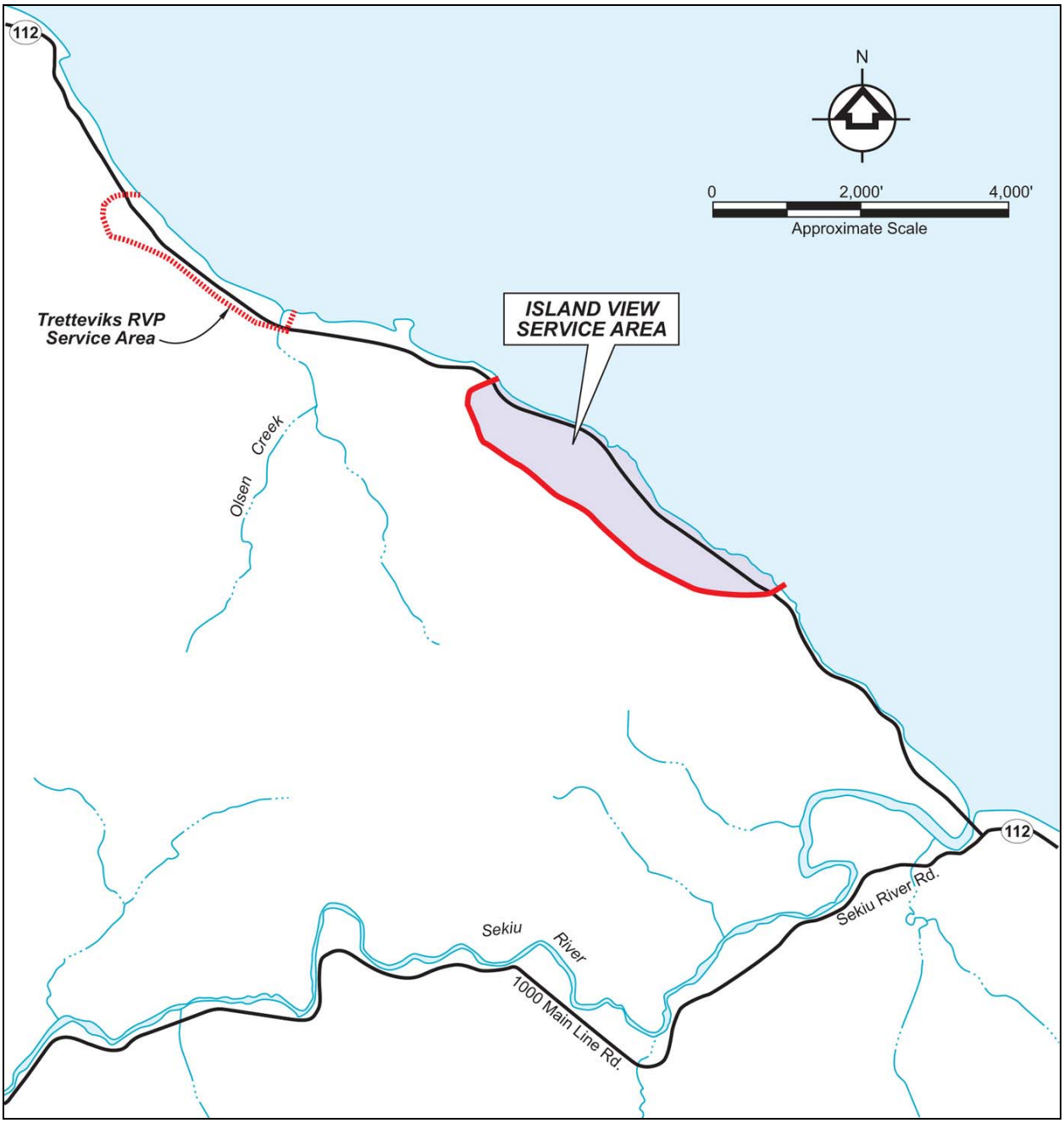

Figure 2-3. Island View Service Area

SUMMARY

The water system facilities in WRIA 19 appear to be adequate for the foreseeable future. CWA water demand projections are based on a relatively high growth rate of 2.5 percent. By comparison, King County had an average rate of growth of 1.2 percent annually from 1990 to 2000. Based on these estimates of population growth, the association would have enough infrastructure capacity and water rights availability for the next 20 years. There is a chance that growth will outpace current estimates, but that probability appears to be low and existing capacity could be expanded with the increased efficiency plans that the association is currently implementing.

The Clallam Bay/Sekiu District and Island View Water District projections are based on a projected state growth rate of 1 percent. Given that the service areas for these districts are located well west of the areas of the County that are experiencing rapid growth, this growth estimate appears adequate. If projected growth rates exceed those used in the current analysis, or if the service boundaries are expanded, additional water storage projects are likely to be needed; however, the district appears to have adequate supply for the next 20 years.

Demand for water in areas not currently serviced by a major water purveyor has not been examined. One recommendation of the WRIA 19 instream flow study was to close some rivers and streams to summertime water withdrawals. This would limit the ability of new developments to establish a new water source from surface water. The option of storing surface water during winter to provide a summertime water supply is discussed in the surface water storage section in Chapter 3.

CHAPTER 3.
STRUCTURAL ALTERNATIVES

This chapter discusses structural projects that may have benefits for storage needs. Projects are grouped under the five broad types of structural projects listed in Chapter 1 (surface water storage, natural floodplain storage, aquifer storage and recovery, stream restoration, and supplemental water supply). The broad project types are described below, followed by subbasin-specific descriptions of potential structural alternatives identified in this study.

TYPES OF STRUCTURAL PROJECTS

Surface Water Storage

On-Channel vs. Off-Channel Storage

Because there are no existing surface water reservoirs in WRIA 19, there is no option to modify existing reservoirs to accommodate more storage. Therefore, the only option for surface water storage is to create new reservoirs. New reservoirs can be divided into two categories based on their location with respect to the river or stream: on-channel and off-channel. An on-channel dam is sited directly in the channel of a river or major stream and is filled directly by flow from the upstream drainage basin.

The benefits and drawbacks of surface water reservoirs are well documented. For on-channel reservoirs benefits include the following:

- They provide the potential for flood control.
- The water supply is located at the site.
- River valleys are capable of storing a large volume of water.

Drawbacks of on-channel reservoirs include the following:

- They pose a barrier to fish passage.
- Sediment from the river can fill in the reservoir, decreasing storage over time.
- Creation of the reservoir often requires relocation of people and infrastructure.
- Extensive permitting and mitigation are required.
- The reservoirs have a significant overall environmental impact.

The advantages of off-channel reservoirs include the following:

- They do not generally represent a significant barrier to fish passage.
- Because the location is somewhat flexible, the reservoir can be sited in an area where it would have less environmental impact.
- Off-channel dams require smaller spillways and outlet works than on-channel dams.

The disadvantages of off-channel reservoirs include the following:

- Extensive conveyance infrastructure is required to get water into and out of the reservoir.

- Reservoir leakage and seepage can be a significant problem depending geology and groundwater.
- Off-channel dams are generally more expensive than on-channel dams.

Given the lack of suitable dam sites in the watershed and the environmental impact and expense of on-channel projects, on-channel reservoirs are not recommended as a water storage option in WRIA 19.

Considerations for Off-Channel Storage Facilities

Off-channel storage is accomplished by storing water outside the channel of the river or stream. Given the sparse population in WRIA 19, the potential demand on surface water reservoirs may be small enough to consider storage tanks or constructed reservoirs instead of dams as a method of surface water storage. During the winter, water could be stored in tanks and used to replace or supplement groundwater withdrawals—particularly where wells are tapping aquifers that are hydraulically connected to streams.

If off-channel surface storage of winter flows were used to supply water during the summer, the amount of storage needed to provide water for 200 homes for 120 days (approximately the amount of time that withdrawals may be restricted in summer under a recommendation of the WRIA 19 instream flow study) would be approximately 19 million gallons, or 60 acre-feet (based on 800 gallons per day per home). Storing water from the winter months to the summer months may create water quality and aesthetic (taste and appearance) problems since the residence time for water in the storage reservoir would be high; this could create the need for additional maintenance or treatment.

Clallam PUD #1 and the CWA operate several storage reservoirs (these are small reservoirs because they store only enough water to meet day-to-day demands). Currently, the CWA is considering adding two reservoirs to its water supply system to supply expected growth and to meet fire-flow needs. The reservoirs would provide approximately 250,000 gallons of additional storage

Natural Floodplain Storage—Restoring Wetlands and Floodplain Connectivity

Wetland restoration encompasses many types of projects, including increasing habitat diversity, riparian revegetation, and floodplain reconnection. The projects presented in this report would increase the volume of storage in a wetland, increase the wet area of a wetland, or increase the time that a wetland contains water. Such projects include reconnecting overbank areas to the floodplain, inundating historical wetland areas, and increasing the water depth in existing wetlands.

While a wetland stores water on the surface, its primary benefit with respect to water storage is to maintain higher groundwater levels that help enhance base flows as the groundwater feeds into streams. Groundwater tends to be cool—sometimes significantly cooler than stored surface water in the summer—and when discharged to streams it helps maintain healthy summer stream temperatures.

Wetlands are typically fed by a combination of sources, including groundwater and (in a floodplain setting) overbank flood flows. These overbank flood flows provide water to wetlands and reduce flood damage by using the natural floodplain storage provided by wetlands. Floodplain wetland storage is unavailable where floodplain wetlands are disconnected from the stream by levees, dikes, incised channels and barriers such as roads. This in turn contributes to lowered base flows in streams.

Wetland restoration is a vital component of restoring a healthy biological and hydrological regime. While an individual project may contribute only a small amount of storage compared to a reservoir, wetlands provide many additional benefits including flood control, wildlife habitat, and water quality benefits. For

this report, it was assumed that expanding or restoring wet areas would recharge the groundwater in these areas and raise the groundwater table—particularly in the summer. Both water quantity and water quality are highly dependant on maintaining adequate summer flows, which are dependent on groundwater.

Quantifying the amount of storage that would be made available by wetland restoration projects is complex and beyond the scope of this study. For the purposes of this report, water storage benefits are measured in the amount of wetland area that is restored. While this is a reasonable evaluation tool, only a site-specific evaluation could quantify the relationship between infiltration, groundwater storage and surface water base flows. In order to truly evaluate the effectiveness of a project, a detailed study that would quantify this relationship is needed to determine the water storage potential of the project.

Aquifer Storage and Recovery

Aquifer Storage and Recovery (ASR) is a process by which an aquifer is recharged with excess runoff or groundwater that is stored in the aquifer until it is needed at a later time. The recharge process typically occurs by means of an injection well. Infiltration ponds can also be used to recharge the aquifer if topography and geology are suitable. In WRIA 19, ASR would most likely use a well field for both the recharge and extraction of the water.

ASR has proven feasible in both confined and unconfined aquifers. However, in order for the ASR process to be successful, the aquifer boundaries must be well defined, the aquifer must retain the stored water until it is needed, and the water must remain free of contamination. The primary concern with unconfined aquifers is the potential for contamination from overlying land uses. While contaminants may penetrate the confining unit, or aquitard, of a confined aquifer, the risk is much less than in an unconfined aquifer (Landauer, 1998).

Compared to surface water storage projects, ASR has little impact on fish and wildlife habitat. The main impact on fish would likely occur at the point where the aquifer recharge water is originally diverted or withdrawn from its source (before injection). Because recharge withdrawals from streams or rivers would occur during wet winter months, the impact on instream flows would be minimal. Other environmental impacts may be caused by the well field and distribution infrastructure, but the infrastructure necessary for ASR generally is minimal – relative to surface water storage projects.

The information presented in this report is based on existing information. Currently, there has been little attempt to comprehensively characterize the aquifers in WRIA 19. As a result, additional investigation should be done before conclusive recommendations can be made regarding the efficacy of ASR in WRIA 19. A qualitative assessment of ASR could be watershed-wide, but because of the needed infrastructure, ASR analysis for this report focuses on the Salt Creek and Clallam River subbasins, which are the most populated and would likely have the most need for a way to offset summer consumptive use.

Stream Restoration

Stream restoration projects address streams that are suffering from channel incision and degraded riparian conditions and are no longer connected to natural floodplain storage. The general concept is to restore stream base levels in order to slow the winter flows and promote more channel/floodplain interaction. Like wetland restoration projects, stream restoration projects provide water storage as an indirect benefit. Other benefits to stream restoration include flood control, wildlife habitat, and water quality benefits.

As with wetland restoration, quantifying the amount of storage that would be made available by stream restoration projects is complex and beyond the scope of this study. For the purposes of this report, water storage benefits are measured in the amount of area that is restored. While not necessarily an indication of

effectiveness as a water storage project, this metric provides a basis of comparison between projects and can be used to develop a conceptual cost-benefit analysis.

Supplemental Water Supply

Only one option was assessed for providing a water supply from other sources to supplement the supply available from surface water: the use of treated, reclaimed wastewater. This option was evaluated only for the Clallam River Subbasin, and is described in the discussion for that subbasin later in this chapter.

POTENTIAL PROJECTS IN SALT CREEK SUBBASIN

The Salt Creek Subbasin is one of the more densely populated areas of WRIA 19 and is experiencing rapid population growth relative to the rest of WRIA 19. This region is served by the CWA, which appears to have adequate infrastructure and water rights from the Lyre River to provide water for at least the next 20 years. Additional water storage alternatives to supply water for consumptive uses were not evaluated.

Lack of adequate base flows appear to be a problem in the Salt Creek Subbasin. The report *Salt Creek Watershed: An Assessment of Habitat Conditions, Fish Populations and Opportunities for Restoration* (McHenry et al., 2004) indicates that the main stem of Salt Creek is disconnected from its floodplain along nearly 50 percent of its length and proposes the following restoration actions to reconnect the floodplain to the creek. The loss of historical wetland area is a significant but unquantified impact on Salt Creek. In addition to habitat loss, the loss of wetlands has likely led to increases in peak flows and reductions in groundwater storage and base flows (McHenry et al, 2004).

Surface Water Storage

Projects to Control Runoff

There are no suitable locations for inline reservoir construction within this subbasin. In addition, because of environmental impacts and high cost, the possibility for a dam to be built is very low. However, an off-line storage reservoir may be a feasible option. The most likely form for an off-line reservoir would be storage tanks or vaults to capture surface water runoff from impervious areas during peak flow events. This runoff could be stored and released during drier months in order to augment stream flows.

Underground storage tanks or retention ponds could be used to capture and retain surface water runoff and release it slowly back into the creek system in order to maintain summer base flows. This approach is similar to the stormwater mitigation being used for the third runway expansion at Sea-Tac Airport. The storage system would likely be most effective at a central location rather than located on-site for each new development. Funding could be accomplished by establishing impact guidelines that require developers to partially fund the construction and maintenance of the system rather than requiring them to store runoff on-site. This system could operate in a similar fashion to “wetland banks” currently being developed in Pierce and King Counties. Growth in this basin is expected to be modest; however, based on the rapid growth in Sequim and Port Angeles, growth could be faster than is currently anticipated and future demand may be strong enough to fund this project.

Natural Floodplain Storage

Abandon Camp Hayden Spur Road

Camp Hayden Road is a riparian road constructed along the main stem of Salt Creek from River Mile (RM) 1 to RM 2 (see Figure 3-1). The road was built by the U.S. Army for access to troop barracks that have since been abandoned. The road, which is located on County land, is approximately 4,000 feet in length and provides no access to any public or private facilities. Along much of its length, the road prevents lateral migration of Salt Creek and disconnects the creek from potential wetlands and side channels. This project would abandon the road and restore the floodplain along the creek. Approximately 3 acres of floodplain could be restored by removing the road prism and replanting the riparian corridor.

Aquifer Storage and Recovery

CWA, the primary water provider to the Salt Creek Subbasin, currently has one source on the Lyre River. While the Salt Creek Subbasin contains 240 of the 381 well records in WRIA 19 (Ecology, 2004), there is no centralized well field that provides a source for water distribution. Most of the wells in the subbasin are exempt single-use wells. This lack of a centralized water distribution system is the first obstacle in developing a useful ASR system. The current distribution of exempt wells is too broad to greatly benefit from a single injection well field. In addition, because many of the surficial aquifers in the subbasin are so shallow they are vulnerable to contamination, and injecting water into them may increase the risk of groundwater flooding.

Aquifers located in the deeper glacial deposits or the bedrock aquifers may be more appropriate for an ASR project. However, well yields in these aquifers have typically been small (typically 2 to 10 gpm), and the extent of the aquifers has not been documented.

Stream Restoration

Treatment of Channel Incision at River Miles 2.0 - 4.0

Channel incision has contributed to the loss of wetlands in the subbasin. The Salt Creek channel is incised from RM 0.5 to RM 0.6. This project, currently submitted for a Bureau of Indian Affairs (BIA) grant, proposes to add large woody debris (LWD) to the stream in an effort to restore the stream's base level. This section of Salt Creek exhibits channel incision of up to 1.5 meters vertically and includes bedrock and plane-bed channel morphologies. This reach of Salt Creek includes historically heavily logged riparian areas and channels subjected to intentional LWD salvage in the 1950s by the State of Washington in order to improve fish passage. All complex logjams were removed in this project and Salt Creek's riparian forests have been historically logged without buffers (at least twice). Channel incision in portions of this reach has converted alluvial channels to bedrock. In other reaches, forced pool-riffle morphologies have been converted to plane-bed types. These changes have eliminated or reduced spawning habitat, reduced rearing habitats, and isolated floodplain habitat from the main stem of Salt Creek.

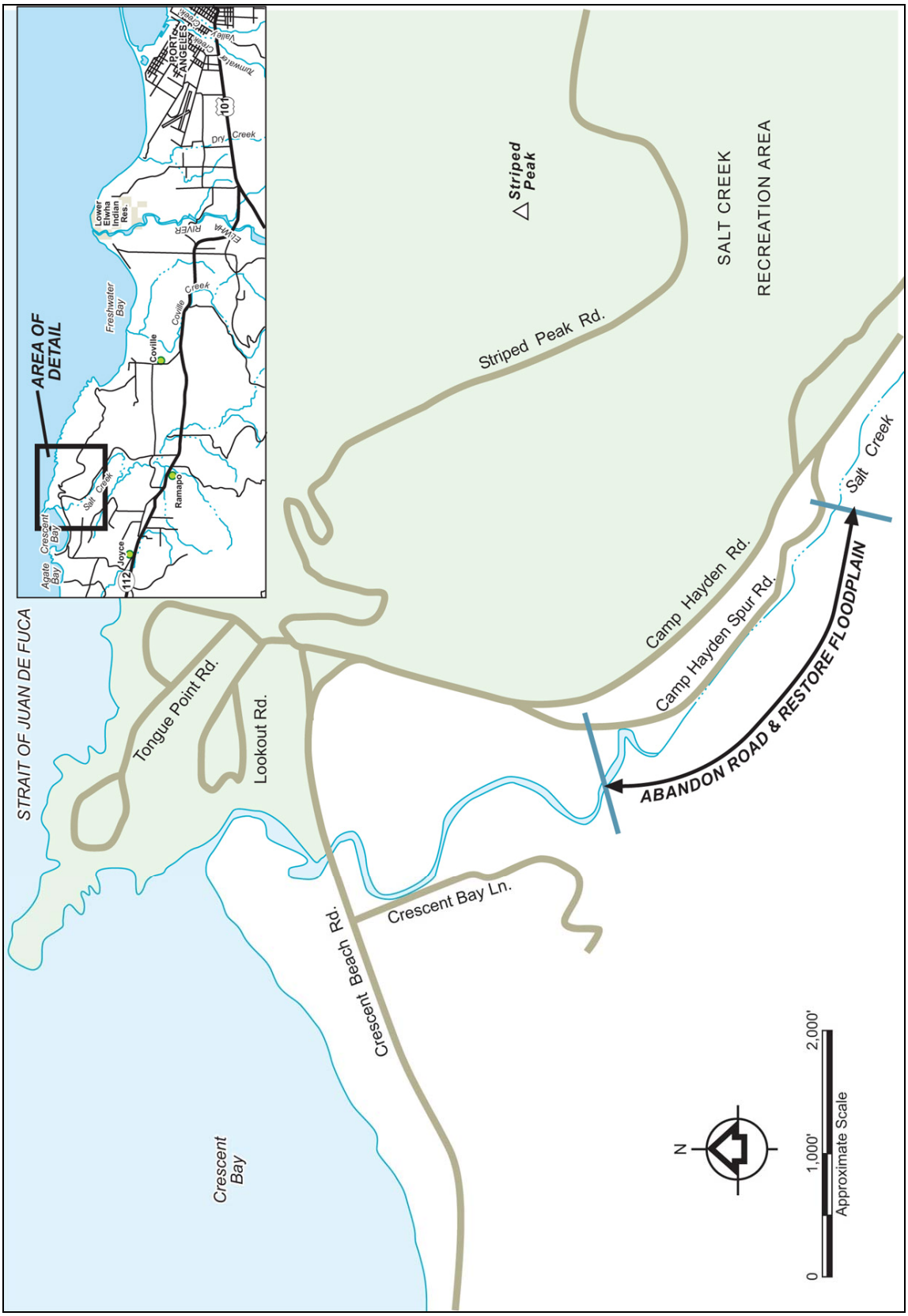

Figure 3-1. Camp Hayden Road Abandonment Project

This project would add LWD in the form of single key pieces or in complex accumulations (logjams) between RM 2.0 and RM 4.0 on property owned by Green Crow Timber Company. Additions of high quality LWD are necessary to provide aggradation storage sites in order to reverse incision processes and allow reconnection to Salt Creek's floodplain. The horizontal reconnection of habitat has been identified as the second highest priority for restoration in Salt Creek. This problem is treatable using LWD placement techniques that have been successfully used by the Lower Elwha Klallam Tribe at similar sites throughout the region (Deep Creek, Little Hoko River, East Twin River).

POTENTIAL PROJECTS IN LYRE RIVER AND LAKE CRESCENT SUBBASINS

The Lyre River is the only stream in the Lyre River Subbasin that flows directly to the Strait of Juan de Fuca.

The Lake Crescent Subbasin is unique in WRIA 19 in that a large lake is the headwaters for the Lyre River, providing a natural water storage feature. As a result, water storage projects in the subbasin would be superfluous. If water levels in the lake were to drop, it would more likely be a result of decreased precipitation in the region than consumptive water use. Water storage projects focusing on this contingency would not be practical.

Lake Crescent and its headwaters are located in Olympic National Park, and as a result are relatively undisturbed from their historical condition. The subbasin is projected to have very low development pressure and therefore low water consumption needs in the future. The major sources of water use in the subbasin are related to the National Park Service and associated private concessions as well as exempt wells providing water to residences on the lakeshore. The three largest concessions in the subbasin are as follows:

- Log Cabin Resort—Log Cabin Resort is located on the east side of the lake. Washington Department of Health (DOH) records indicate that the water system for the resort has six connections.
- Lake Crescent Lodge—Lake Crescent Lodge is located on the south shore of the lake at Barnes Point and provides water for 46 connections according to DOH records.
- Fairholm Campground—Located on the west side of the lake, Fairholm Campground is operated by the National Park Service and provides water for six connections according to DOH records.

Because the water needs for this basin are comparatively small with respect to other subbasins and appear to be sustainable for the foreseeable future, no water storage projects are proposed.

Surface Water Storage

Water Supply Storage

The primary water supplier in this portion of WRIA 19 is the CWA, so surface water storage in the Lyre River Subbasin would likely be linked with any existing CWA infrastructure. Currently and for the foreseeable future, the Lyre River is the sole source of water for the CWA. As demand in the district increases, additional storage in the subbasin would likely be required to offset potential impacts on the river.

The existing outtakes for the CWA supply are located on the Lyre River. Any additional storage facilities for water supply would likely store water from the Lyre River in order to take advantage of the existing

infrastructure for water treatment and distribution. Current water demand estimates indicate that the district has sufficient supply facilities to meet current and future demands (20-year projection). However, if current growth projections are exceeded, if the existing service area is expanded, or if instream flows in the Lyre River reach levels critical enough to warrant a large capital project, additional storage may be added to offset the demand on the river.

In order to reduce the impact on summer low flows, future summer withdrawals could be limited while existing water rights could be expanded during the winter, with the excess water being stored for consumption during the summer. This would require additional storage tanks as well as an operational plan to oversee proper management of the seasonal fluctuations in water availability.

Stream Restoration

Restore the Lowest Mile of Lyre River

This potential project would have indirect storage benefits from stream restoration reducing channel incision on the lowest mile of the Lyre River. Information on this project is still being collected.

POTENTIAL PROJECTS IN TWIN RIVERS SUBBASIN

By most accounts, the Twin Rivers Subbasin is in relatively good condition with respect to maintaining summer base flows. According to the habitat assessment, there is very little restriction in floodplain connectivity along the East and West Twin Rivers. There does not appear to be a significant increase in runoff during average storm events. LWD conditions are impacted in areas where logging is most active (Smith, 1999).

Natural Floodplain Storage

Logjams/Wetland Restoration

Building full-spanning log jams on tributaries would direct backwater to large wetland areas and promote aquifer recharge. Additional benefits from logjams include flood storage for peak flows and reducing the sediment load in the stream. Potential locations are shown in Figure 3-2 and include the following:

- Sadie Creek just above FS 3040 Road
- Left bank tributary to Sadie Creek between 3040 Road and the confluence with the East Twin River
- East Fork of the East Twin River just above the 3040 Road
- Confluence of the East Fork and Main Stem of the East Twin River
- Main stem of the East Twin River above the East Fork confluence
- Main stem of the East Twin River above Sadie Creek
- All non-fish bearing streams above the 3040 Road.

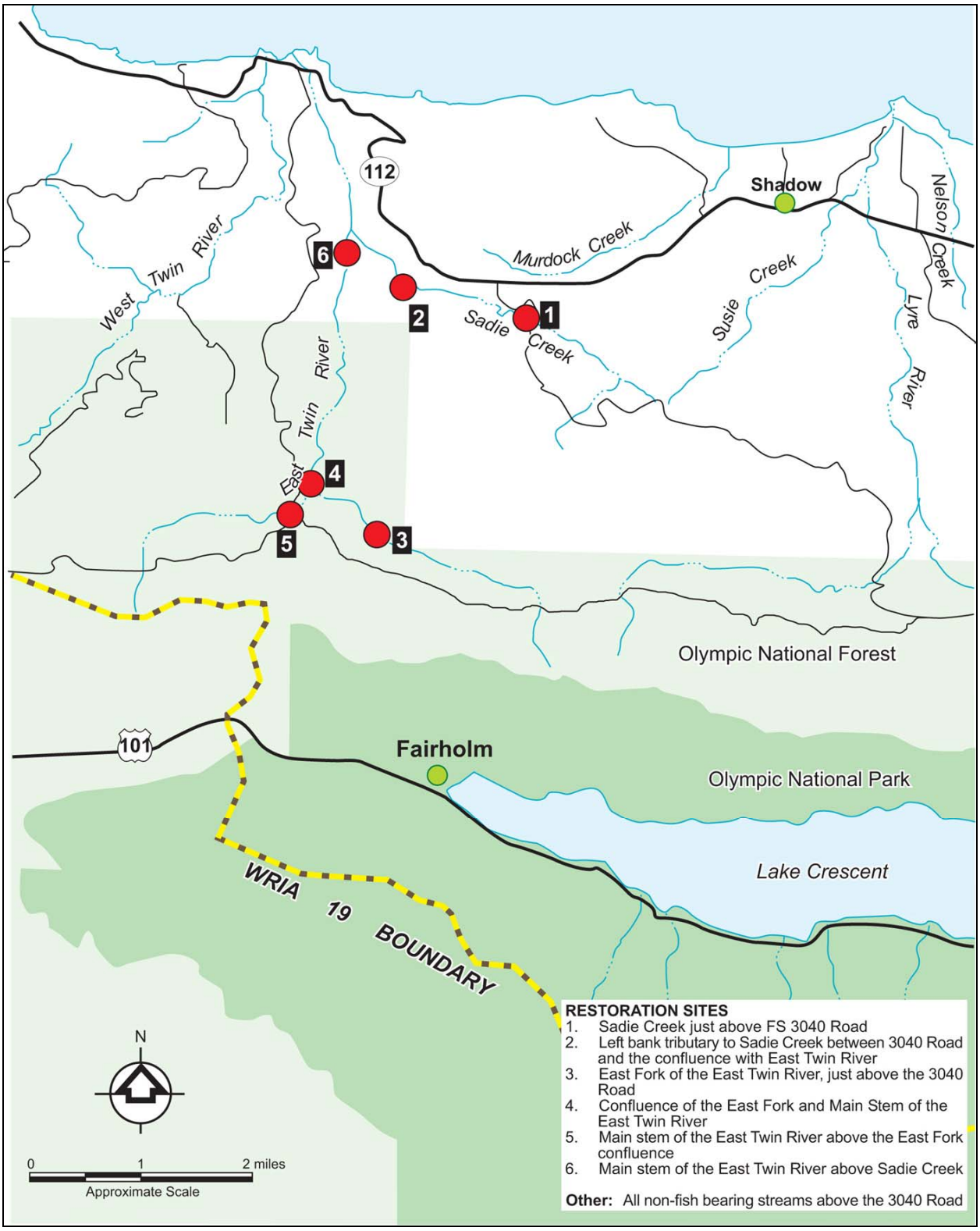

Figure 3-2. Potential Restoration Project Sites in Twin Rivers Subbasin

POTENTIAL PROJECTS IN DEEP CREEK SUBBASIN

Stream Restoration

Remedy Channel Incision

Existing information indicates that large woody debris is as chronically depleted in the Deep Creek Subbasin, while floodplain connectivity is good in the upper watershed. Information on this potential project is still being collected at the time of this draft report.

POTENTIAL PROJECTS IN PYSHT RIVER SUBBASIN

The Pysht River has an elaborate tributary system with many associated wetlands, including a large complex of forested and tidal emergent wetlands near the river's mouth. Historical logging practices have left much of the Pysht River Subbasin deficient of LWD to control bank erosion and flooding and interspersed with roads that disrupt floodplain connectivity.

Natural Floodplain Storage

Restore Wetlands and Floodplain Connectivity

Potential wetland restoration and floodplain connectivity projects are shown in Figure 3-3 and include the following:

- Cascade Timberlands road that disconnects the floodplain from RM 9.8 to RM 11.5 (Limiting factors report)
- Much of the wetland area from the river mouth to the Merrill & Ring Bridge is disconnected from the main stem by a beach road and by diking and dredging for historical log storage in the estuary (Personal communication with D. Hamerquist).
- The Pysht River main stem from RM 1.9 to RM 6 has wetlands that are bisected by the old Merrill & Ring mainline (Personal communication with D. Hamerquist).
- The headwaters of the West Fork of Greens Creek is a major wetland (~1,000 acres) that serves as an important anchor habitat for steelhead, cutthroat and coho (Personal communication with D. Hamerquist). This area would be a good candidate for wetland restoration, especially because it is adjacent to State WDNR-owned land.

Mike McHenry and Mike Haggerty recently completed an inventory of the lower main stem of the Pysht River, identifying fish passage barriers (caused by various sources, including the highway) and ranking potential restoration activities. Their data would provide more specific locations for wetland restoration and floodplain connectivity projects. This information was not available in time to be incorporated into this report.

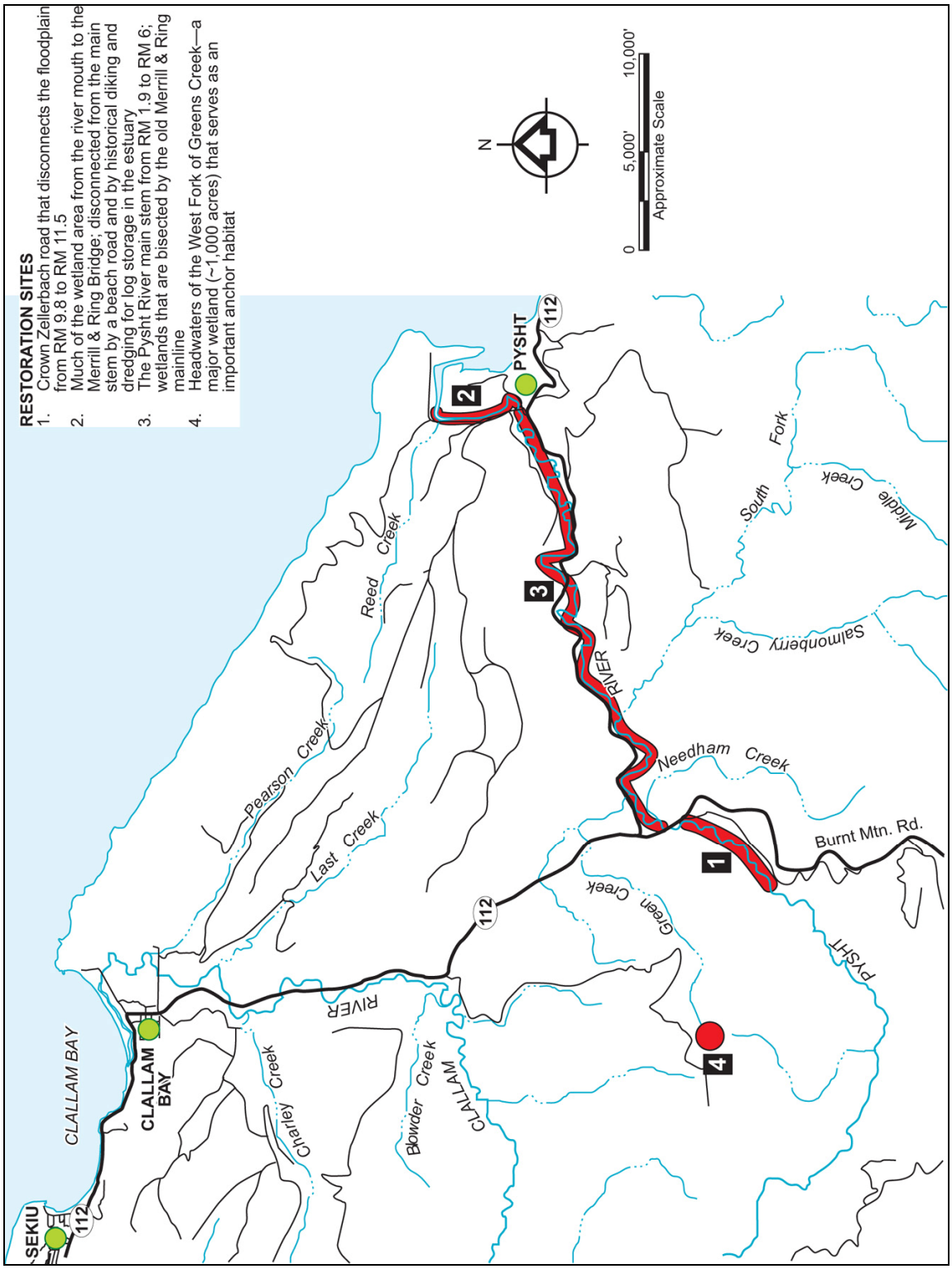

Figure 3-3. Potential Restoration Project Sites in Pysht River Subbasin

POTENTIAL PROJECTS IN CLALLAM RIVER SUBBASIN

Surface Water Storage

Projects to Control Runoff

There are no suitable locations for inline reservoir construction in this subbasin. In addition, because of environmental impacts and high cost, the possibility for a dam to be built is very low. However, an offline storage reservoir may be a feasible option. Since the water supply for the largest water district in the watershed, Clallam County PUD #1, is taken from the Hoko River, storage for water supply is discussed in more detail in the section on the Hoko River Subbasin below. Within the Clallam River Subbasin, the most likely candidate for an off-line reservoir would be storage tanks or vaults to capture surface water runoff from impervious areas during peak flow events. This runoff could be stored and released during drier months in order to augment stream flows.

Underground storage tanks or retention ponds could be used to capture and retain surface water runoff and release it slowly back into the river system in order to maintain summer base flows. The storage system would likely be most effective at a central location rather than located on-site for each new development. Funding could be accomplished by establishing impact guidelines that require developers to partially fund the construction and maintenance of the system rather than requiring them to store runoff on site. This system could operate in a similar fashion to wetland banks currently being developed in Pierce and King Counties. Growth in this basin is expected to be modest; however, based on the rapid growth in Sequim and Port Angeles, growth could be faster than is currently anticipated and future demand may be strong enough to fund this project.

A project of this scope would require significant additional infrastructure in order to provide a measurable boost for summer flows. The amount of storage required would be quite large. Providing a 1-cubic-foot-per-second (cfs) increase in flow for a period of one month would require a volume of approximately 60 acre-feet, or 19 million gallons. Storage costs would likely be on the order of $1 per gallon. The benefit of such a project would not warrant the cost of construction.

Aquifer Storage and Recovery

The Clallam River Subbasin is the second most populated subbasin in WRIA 19. As such it warrants investigation into the possible use of ASR to augment consumptive water supplies. With only 15 well records available in the Clallam River Subbasin, there is not a lot information available to evaluate ASR possibilities. Most wells are located in the shallow alluvium of the Clallam River near Clallam Bay. ASR is not suitable in alluvium due to the high hydraulic connectivity with the river. Water injected into the aquifer would likely flow into the river rather than be stored.

High iron and chloride levels have been reported in a few wells and have hampered efforts to develop new water supply sources. These issues would affect the ability to establish an ASR project. Information on bedrock aquifers is limited and yields have tended to be low (2 to 10 gpm). Based on the available information, there does not appear to be a suitable aquifer to pursue an ASR investigation further.

Supplemental Water Supply

Reclaimed Water

Wastewater recycling can offset the need for additional water storage. In areas where there is a centralized wastewater collection system, recycled wastewater becomes a feasible option for augmenting the water

supply. According to *Water Reclamation and Reuse Standards* (Ecology, 1997), reclaimed water can be used for the following uses, depending on water quality:

- Irrigation
- Impoundments (landscape or recreational uses)
- Fish hatcheries
- Flushing of sanitary sewers
- Various municipal and industrial uses
- Construction uses
- Groundwater recharge
- Stream flow augmentation
- Wetland water supply.

The Clallam River Subbasin has the only centralized wastewater treatment systems in WRIA 19. Elsewhere in the watershed, drainfields and septic systems are the primary means of wastewater disposal. There are two treatment facilities in the subbasin: one at the Clallam Bay Correctional Facility and the Clallam Bay/Sekiu municipal treatment plant. Currently, the treated effluent from both treatment facilities is discharged to the Strait of Juan de Fuca.

The Clallam Bay Correctional Facility treats an estimated 0.1 million gallons per day (mgd) while Clallam Bay/Sekiu plant treats approximately 0.06 mgd. The Clallam Bay Correctional Facility offers the best opportunity for a reclaimed water program, given the larger treatment volume and its higher position in the subbasin. Using the current treatment estimates, the correction center would provide a supply of reclaimed water of 0.15 cfs on average, and the Clallam Bay/Sekiu plant would provide approximately 0.10 cfs.

POTENTIAL PROJECTS IN HOKO RIVER SUBBASIN

Surface Water Storage

Water Supply Storage

The primary water supplier in this subbasin is the Clallam County PUD #1. The PUD's water supply source is a well field adjacent to the Hoko River. Any additional storage facilities for water supply would likely store water from the Hoko River in order to take advantage of the existing infrastructure for water treatment and distribution. Current water demand estimates indicate that the district has sufficient supply facilities to meet current and future demands (20-year projection). However, if current growth projections are exceeded, if the existing service area is expanded, or if instream flows in the Hoko reach levels critical enough to warrant a large capital project, additional storage may be added to offset the demand on the river.

In order to reduce the impact on summer low flows, future summer withdrawals could be limited while existing water rights could be expanded during the winter, with the excess water being stored for consumption during the summer. This would require additional storage tanks as well as an operational plan to oversee proper management of the seasonal fluctuations in water availability.

Stream Restoration

Hoko River Habitat Restoration (5900 Road near Ellis Creek)

A reach-scale stream restoration is proposed for a unique and historically complex floodplain section of the Hoko River, at its confluence with two major tributaries: Ellis Creek and Creek 191. The project would improve instream habitat complexity, floodplain connectivity, side channel availability, salmonid tributary access, and riparian function, while reducing chronic bank erosion. Figure 3-4 shows the location of this project.

Hoko River Riparian Restoration (Lower Hoko River on Cowan Ranch)

Grazing and pastureland are a significant cultural attribute of Cowan Ranch. Where grazing has little impact on stream health, there are no plans to convert pastureland back to forest. However, there is one planned project roughly 2 miles upstream from Cowan Ranch that would convert 14 acres of pastureland back to forest. This project will probably take place in 2006-07. A possible additional element of this project would create some off-stream habitat where a small intermittent stream crosses this area. Figure 3-4 shows the location of this project..

POTENTIAL PROJECTS IN SEKIU RIVER SUBBASIN

The Sekiu River Subbasin has a very low population density and is dominated by forestry activities. As a result, nonstructural storage options, discussed in Chapter 4, are the most relevant for this subbasin; specifically those that address road abandonment projects. The Planning Unit has pointed out that the Makah Tribe has been implementing stream restoration projects and that log jams and restoration projects should be considered. Specific projects were not highlighted for this subbasin due to lack of specific information. Projects may develop as a result of the stream walk inventory and wetland inventory, which are nonstructural projects discussed in Chapter 4.

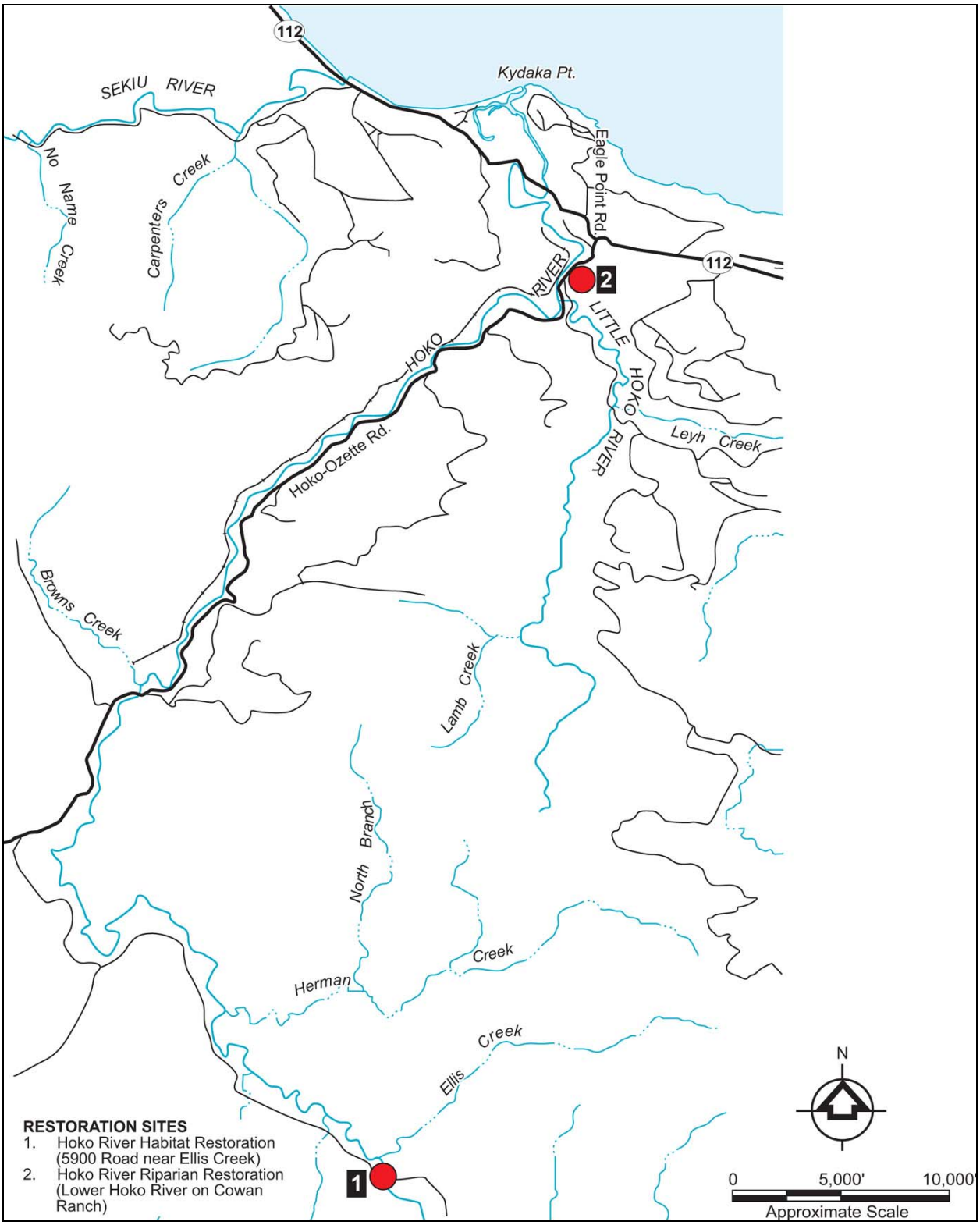

Figure 3-4. Potential Restoration Project Sites in the Hoko River Subbasin

CHAPTER 4.
NONSTRUCTURAL ALTERNATIVES

WRIA-WIDE NONSTRUCTURAL SOLUTIONS

Promote Maintenance of Lands in Forest Management

Overview

As forests have been cleared and water has been diverted by road systems, the natural hydrology of the system has been impacted. Manifestation of these impacts include decreased evapotranspiration, increased runoff, and decreased infiltration to groundwater and base flow of streams. (Winter, 1998). The relationship between vegetation and groundwater infiltration and storage is very complex. Variables that affect the process include season, climate, antecedent conditions, soil characteristics and vegetation type. Some research has been done to quantify the effects that forest removal has on infiltration rates and groundwater contribution in general; however, no study has been done in WRIA 19. Most studies that have been done estimate the impacts of urbanization on surface water resources. One clear finding of these studies is that surface water runoff increases significantly as forests are removed (Booth et al., 2002). The question that remains largely unanswered is how much of that increased runoff would have infiltrated and contributed to base flows.

Burges et al. (1997) compared hydrologic behavior in forested and urbanized catchments in King County, Washington. The two catchments studied can be characterized as broad, till-capped plateaus, and although these conditions do not entirely match conditions in WRIA 19, the results should generally apply. The study indicated that subsurface flow dominated the hydrologic process in the forested area. With the removal of forest and urbanization, discharge from lawns and other pervious areas accounted for 60 percent of annual and storm runoff. While studies have indicated that forests increase evapotranspiration, they also have shown that precipitation is stored in the soil for longer periods in forested basins.

More study is needed to quantify the effects of forest harvesting and forest loss on basin hydrology; however, based on the historical conditions in the watershed, it is clear that careful management of forest resources is critical to maintaining a viable hydrologic regime. The Washington Forest Practices Act addresses the negative impacts of forest practices on water quality and endangered species. Due to the negative impacts of historical logging practices on watershed resources, the Forest Practices Act made substantial changes to forest practices that should improve ecosystem conditions over time and meet the standards of the federal Clean Water Act and Endangered Species Act. The adaptive management aspect of the Forest Practices Act allows for adjustments in forest practices management and regulation without resorting to TMDL (total maximum daily load) limits or endangered species listings.

Potential Projects

Commercial forestry is by definition a commercial enterprise that derives its income from the land. If an owner of forestlands is unable to profitably manage the land, the land could be developed or sold to a new commercial owner who may not be vested in local interests. Innovative projects that reduce the impact on the watershed while maintaining income for the commercial interests need to be examined. Examples of such projects include the following:

- Forest Company Subsidies—In the interest of maintaining quality of life and reducing the impacts of clear cuts, it may be economically feasible to provide subsidies for

companies that follow a land-management plan that would reduce clear-cutting and encourage long-term forest rotation. The cost/benefit relationship of such a program would have to be explored in more detail.

- Carbon Trading—A system of carbon credit trading could be established, similar to the one currently implemented by the Kyoto Treaty. Legislation could be established that would allow industries to emit excess carbon by buying credits that would maintain or restore forests. Currently the United States has not ratified the Kyoto Treaty and is not participating in carbon credit trades; however, this could change in the future and the WRIA could be in a position where the forests are more economically valuable unharvested.

The above projects are presented as examples. Considerably more research is needed to determine their feasibility.

Encourage Low-Impact Development

Overview

Extensive regional and national research shows a clear link between development in a watershed and degradation of aquatic resources. Conventional stormwater management practices have not always proven successful at fully mitigating for the effects of development. As the population in WRIA 19 continues to grow, the accompanying development may have negative impacts on the watershed's water resources. One of the negative impacts will be increased runoff and reduced infiltration that accompany an increase in impervious surface.

In a forest environment, stormwater is handled by a variety of mechanisms, including floodplain storage, channel storage, infiltration, interception, and small depression storage. These mechanisms attenuate peak flows and distribute stormwater uniformly throughout a basin. Low-impact development (LID) uses vegetation and small-scale hydrologic controls to capture, treat, store, and infiltrate runoff on-site, at its source. This helps to maintain the natural hydrology of a site and its watershed as development occurs. The LID approach contrasts with the traditional approach of capturing, piping, and conveying stormwater away from the site.

LID does not refer to growth management or density restrictions; rather, it emphasizes planning to minimize hydrologic impacts. LID practices such as reducing impervious surfaces, decreasing the use of storm drain piping and inlet structures, and eliminating or reducing the size of large stormwater management ponds can significantly reduce development costs. LID is a comprehensive design program that contains the following elements:

- Preservation of native vegetation, natural drainages and porous soils
- Reduction and disconnection of impervious surfaces
- The use of numerous, small-scale hydrologic controls throughout a site
- Clustering of development.

By mimicking the natural processes of a watershed, LID may enhance base flows as water is infiltrated and stored as groundwater. LID also reduces peak flows from stormwater runoff, thus reducing the potential for flooding downstream of the development.

Potential Projects

Policies encouraging LID could be implemented to reduce the impact from future development in the watershed. Clallam County could encourage LID through incentives, particularly in its development and stormwater regulations. The County is currently participating in a Puget Sound Action Team project to develop regulatory code language to encourage LID. This pilot study should be built upon to develop administrative systems and technical expertise within the County to promote LID projects.

A method that could be used in existing developments is to minimize the amount of impervious surface that is directly connected to a storm drain network (referred to as the "effective impervious area"). A simple and inexpensive way to reduce effective impervious area is to disconnect downspouts that are connected to the drainage collection system and redirect them to pervious areas where the runoff can infiltrate. This can be done by individual property owners if they are made aware of the benefits and are instructed how to do it without concentrating flow and instigating new problems. A public information program should explain the effects of impervious area and how individuals may mitigate some of these effects.

Promote Water Conservation Policies/Projects

Increased water conservation reduces the amount of water being withdrawn from surface water and groundwater sources, leading to less impact on water supply sources. Water rate structures can be adjusted to promote conservation by charging more for water usage above a specified volume. Such a rate structure can encourage larger water consumers to use water more efficiently. Addressing water losses within a water purveyor's supply system would also lead to less demand on supply sources. This had the added benefit of increasing the population that can be served from existing supply sources.

Re-establish Beaver Populations

Overview

Beaver populations, which historically were common and abundant throughout the watershed, have been severely reduced by trapping and hunting. Beavers are important regulators of aquatic and terrestrial ecosystems, with effects far beyond their food and space requirements. Beavers modify stream morphology and hydrology by cutting wood and building dams. This in turn influences a variety of biological responses in and adjacent to stream channels. Much of the following information has been drawn from the draft report *Stream Habitat Restoration Guidelines* (Saldi-Caromile et al., 2003) produced by several Washington State government agencies.

The abundance of beavers drew early trappers and explorers to the Northwest. By 1900, continued exploitation left beavers almost extinct. Their removal resulted in incised channels, loss of riparian and wetland areas, and loss of channel complexity critical to fish and invertebrate production. Historically, beavers have been key agents of riparian succession and ecology throughout North America.

Further study into the possibility of beaver reestablishment is necessary, including an analysis of historical range and population size. Beavers are still present in the watershed, as indicated by downed trees in several locations. It is possible that populations are currently reduced due to a lack of food.

Potential Benefits

According to *Stream Habitat Restoration Guidelines*, the following benefits have been documented where beavers have been reintroduced:

- Water tables have been elevated (which improves vegetation condition), water velocities, erosion and sedimentation reduced, fish habitat and water quality improved, water storage increased, and waterfowl nesting and brooding areas increased. The beavers' effect is also important relative to population dynamics, food supply, and predation.
- Beaver dams on headwater streams can positively influence riparian function in many ways. They improve water quality by trapping sediments behind dams and by reducing stream velocity, thereby reducing bank erosion. Beavers can influence the flow regime of a watershed. Beaver ponds create a sponge-like effect by increasing the area where soil and water meet. Headwaters retain more water from spring runoff and major storm events, which is released more slowly, resulting in a higher water table and extended summer flows. This increase in water availability, both surface and subsurface, usually increases the width of the riparian zone, and consequently favors wildlife communities that depend on that vegetation. Richness, diversity, and abundance of birds, fish, reptiles, and mammals can be increased by beaver activities.
- Beaver ponds are important waterfowl production areas and can be used by waterfowl during migration. Beaver ponds provide important salmon habitat in Western Washington. Juvenile coho and cutthroat are known to over-winter in beaver ponds and the loss of beaver pond habitat has resulted in the loss of salmon production potential.
- By starting in first-, second-, and sometimes third-order drainages, or below areas of erosion, beaver activity and stream sediment transport can re-elevate the bed level of incised channels, reactivate floodplains, increase stream bank water storage and aquifer recharge, and increase sediment deposition and storage.
- Once beaver complexes become established and are self-sustaining (in three to four years), the complexes begin to form natural gully plugs up to a half-mile in length (depending on stream gradient), accelerating sediment deposition and riparian recovery further upstream. By facilitating the establishment of beaver dam complexes at intervals along a drainage or throughout a watershed, this process can create a leap frog effect, helping to accumulate or stabilize sediment in place throughout the system.
- Beavers can be used to initiate or accelerate the natural restoration of degraded or lost riparian systems. Identifying limiting factors and providing supplemental management techniques to compensate for these factors are important. With physical site conditions improved for initiation of natural riparian establishment, the system can develop to a self-sustaining level in as little as three to four years. By transplanting beavers to degraded sites, providing supplemental dam material during initial construction (to reduce dam washout prospects), and maximizing vegetative re-growth and establishment, riparian recovery and succession can be accelerated.

Potential Adverse Impacts

Beavers can disrupt the habitat of other wildlife species. Negative impacts include loss of spawning habitat, increase in summertime water temperatures beyond optimal levels for some fish species, loss of riparian habitat, barriers to migration for some fish species, and habitat conversion. Therefore, caution should be used in introducing beavers into areas where they were not endemic.

Beavers may become a nuisance if their activities conflict with other objectives for a stream. Common problems include cutting or eating desirable vegetation, flooding roads or irrigation ditches by plugging culverts, and increasing erosion by burrowing into the banks of streams or reservoirs. In addition, beavers

carry Giardia pathogens, which can infect drinking water supplies and cause human health problems. In these areas, it is important to work in cooperation with adjacent landowners, transportation officials, and water purveyors.

Potential Projects

Beavers are often viewed as a nuisance species by landowners because of the impacts they have on streams. Often, current land use is not compatible with the effects beavers may have on land. As a result, efforts to import beaver into an area or to explicitly expand the beaver population could be highly contentious and are not recommended. However, many people may not be aware of the important role beavers play in the ecosystem. Therefore, the recommended solution contains the following elements:

- Emphasize the benefits of beavers in public information.
- Encourage landowners not to automatically remove beavers when they are found in an area.
- Establish a relocation program for nuisance beavers.

Rather than endorse a program that would explicitly expand the existing beaver population. Efforts to restore riparian areas could include elements that would support beaver. By ensuring an adequate food supply with willow stakes and coniferous plantings, the beaver population should naturally expand to fill habitat over time. This would essentially be restoring a stream to its natural condition—a condition that has historically served as habitat for beavers and other animal populations. The ultimate consequence of this restoration would be hydrologic improvements that would promote healthy stream flows.

Forest Practices Information and Communication Forums

Commercial forestry dominates WRIA 19's land uses and can have a significant impact on natural hydrologic processes. Smith (2001) has indicated that limiting factors affecting salmon and steelhead habitat can be addressed by enforcing existing environmental regulations. Some of the factors that affect salmon and steelhead habitat also affect the natural processes of water storage within the watershed.

The Washington Department of Natural Resources (WDNR) reviews and issues permits for timber harvest and associated activities. Once the harvest activity is implemented, the WDNR performs compliance inspections to ensure that the terms of the permit are being met. However, only a portion of forest practice permits are inspected for compliance, based on a prioritized list of site sensitivity. Parameters measured include water quality and fish habitat, though riparian buffer and road best management practices are emphasized. In the Olympic Region, approximately 25 percent of permitted applications are inspected; the results of the regional inspections are not formally reported in a public document (J. Springer personal communication).

As a nonstructural measure, the WDNR should coordinate communication and information forums for stakeholders to understand and provide input on forest practices activities that may impact watersheds and water storage.

Implement Road Maintenance and Abandonment Programs

Overview

Road drainage in the watershed reduces water storage by increasing the amount of runoff from impervious surfaces and intercepting and concentrating shallow groundwater flow. In a forested

watershed such as WRIA 19, overland flow is not a naturally prominent conveyance mechanism. More typically, rainfall infiltrates into the organic matter in the forest floor and travels sub-surface until the water table exceeds the ground elevation, at which point runoff resurfaces and forms ponds or streams. Roads can act as a focus point for flow. Road cuts and embankments can disrupt the natural topography and force groundwater to the surface. When sub-surface flow rises and becomes concentrated on the surface, gullies can form, which can initiate a cycle of erosion and increased flows. As gullies down-cut, more surface water is collected, which can cause more erosion and enlarge the channel, which then collects more water. This cycle can continue until a new equilibrium is reached. The net effect on water storage is that instead of water infiltrating into the ground and recharging aquifers for summer base flow, the groundwater is intercepted and quickly transported to the ocean.

In March 2000, the Washington Department of Natural Resources enacted emergency rules for road management and abandonment practices (RMAP); permanent rules became effective in July 2001. These rules stipulate that for large forest landowners all roads must be improved and maintained to WDNR standards within 15 years of the enactment of the rule. Of particular interest for water storage is the impact that roads have on the interception of subsurface flow, disconnecting road drainage from surface waters, and minimizing water delivery. State and private commercial forest landowners are currently responding to this requirement, and this study reinforces the importance of those efforts. The impact of roads outside of areas currently addressed by the RMAP rules should be examined as well.

Potential Project

High road densities, particularly in the Sekiu and Hoko subbasins, make road abandonment efforts extremely critical. In addition to efforts by state and private landowners under the RMAP program, additional public assistance could be focused on efforts to accelerate abandonment of unneeded forest roads.

Complete a Comprehensive Wetland Inventory

Restoring or maintaining natural hydrologic processes is a key element in the watershed's capacity to store water and maintain summer base flows. Several projects in this report recommend wetland restoration as a way to increase storage; however, these projects likely represent a fraction of potential restoration projects. This is due to the lack of existing information on the historical extent of wetlands. A comprehensive survey of existing and historical wetlands is needed to allow for better identification of future water storage projects. This survey could identify areas where a stream has been disconnected from the floodplain, man-made wetlands have been inadvertently or intentionally created, and areas of hydric soils may have been historical wetlands. Once a database of wetlands has been developed, it can be used to track the destruction or creation of wetlands over time, regulate land use practices, and identify wetland restoration or mitigation projects.

Complete a Stream Walk Inventory

Current stream restoration efforts in WRIA 19 are done on a reach-level rather than a watershed-level scale. Though these projects improve conditions, the river processes that form habitat are out of balance. These processes must be addressed in a holistic manner, or the restoration efforts could be undermined. By performing a complete survey of each stream in WRIA 19, the whole picture can been better understood. Stream walk surveys would locate and document channel and riparian conditions, barriers, water diversions, and other relevant features. These surveys could be used to track conditions and to identify and develop restoration priorities and projects.

Stream walk surveys are ideal for community participation. Citizens, volunteers, student interns and local conservation corps are all highly trainable and eager candidates. Peninsula College, Washington Conservation Corps, Streamkeepers, and the Clallam Conservation District are great resources for relatively inexpensive project assistance.

Provide Mitigation for New Water Rights

One recommendation of the WRIA 19 in-stream flow study was to close some rivers and streams to summertime water withdrawals. This would make establishing new surface water rights very difficult. In instances where new communities or developments need to establish a new drinking water source, but new water rights are restricted, a program could be developed that would allow new water rights in exchange for mitigation within the watershed. The details of such a program would have to be worked out by the stakeholders. The program would encourage compromise to provide a mechanism for sustainable growth.

There are many options for mitigation opportunities within the watershed. One example of a mitigation program is to establish a wetland bank program similar to those being developed in Pierce and King Counties. This program would allow developers to contribute to the restoration and maintenance of wetlands in the watershed. This program has the advantage of creating a large centralized wetland area that could provide a variety of habitats, which would create a self-sufficient ecosystem. Another example is the establishment of a restoration fund that could be used to purchase land or to fund identified restoration projects within the watershed.

LOCATION-SPECIFIC NONSTRUCTURAL SOLUTIONS

Salt Creek Subbasin

Stop Unauthorized Water Withdrawals

According to the limiting factors report (Smith, 2001) unauthorized water withdrawals are a problem in the Salt Creek Subbasin. Direct withdrawals have a significant impact on flows in the creek, especially in the dry summer months. Detection of illegal withdrawals should be a priority since, according to the existing water rights, the subbasin already has a heavy allocation of legal withdrawals. The number of illegal connections and the volume of the withdrawals has not been estimated. This project would commission a survey to identify and estimate the number of illegal water connections in the system. Follow-up actions by the Washington Department of Ecology would curtail any unauthorized diversions. Although this project is identified for the Salt Creek Subbasin due to the subbasin's high population and the poor existing condition of Salt Creek, the project could be implemented throughout WRIA 19. Illegal water withdrawals could be documented as part of the stream walk inventory project discussed previously.

Lyre River and Lake Crescent Subbasins

Increase Efficiency of Existing Water System

The Lyre River is the only source for the CWA water system. According to the CWA, the water system experiences water losses of approximately 15 percent. When unaccounted water use reaches 20 percent of the total water outtake, state law requires that the purveyor's water system plan address ways to increase efficiency. CWA is currently updating auditing procedures as well as adding additional meters and replacing existing water meters in order to better identify loss zones and reduce losses. CWA efficiency measures also will benefit the Salt Creek Subbasin, which is also served by the CWA system.

Coordination between Lyre River and Lake Crescent Subbasins

Lake Crescent forms a major part of the headwaters for the Lyre River, and as such any management actions on Lake Crescent will impact the Lyre River. Currently there is no control structure at the lake outlet, so flow in the Lyre River is controlled naturally by lake level and by contribution from other tributaries. Any future plans by the National Park Service that could have downstream impacts should include coordination and stakeholder involvement from the Lyre River Subbasin.

Twin Rivers Subbasin

Source Protection Study

Past observations indicate that the Twin Rivers are able to sustain base flow longer than the other major water courses in WRIA 19 (Josey Paul, 2005). This is due largely to the fact that the headwaters of the rivers are fed by groundwater springs. The exact location of the springs and the nature of the source aquifer are not known at this time. Protecting the source of flow is of primary importance in the Twin Rivers Subbasin. The aquifer and its recharge area for these springs are not defined. In order to preserve the springs from contamination or destruction, the location of the springs as well as the aquifer recharge zone should be identified and protected.

Pysht River Subbasin

Bank Erosion and Flooding Study

The Washington State Department of Transportation (WSDOT) is in the process of conducting a geomorphic reach analysis along select areas or reaches of the Hoko, Clallam and Pysht Rivers to assess erosion and flood hazards to SR 112 between Port Angeles and Neah Bay. Where SR 112 encroaches on the floodway or channel migration zone of these rivers, it is susceptible to flooding and erosion, which has resulted in repeated road closures and emergency repairs. The most significant threat to SR 112 is bank erosion, which can result in loss of the road prism. In some areas where this has occurred, WSDOT has implemented bank protection measures to ensure the integrity and safety of the highway. However, these actions have resulted in environmental impacts on aquatic and riparian habitat.

WSDOT will conduct a reach analysis to assess previous sites where emergency measures have been implemented, identify potential problem sites, and provide conceptual solutions to protect the highway from erosion and flooding. WSDOT is working with the Lower Elwha Klallam Tribe, the Makah Tribe and other stakeholders (e.g., Merrill and Ring, Inc.) to develop self-mitigating flood and bank protection measures that will safeguard SR 112 while enhancing riparian and aquatic habitat.

Particularly where the highway is located close to the river, this study should consider acquisition of land on the opposite bank of the river for channel migration and floodplain storage. In addition, all bank protection measures should include shade-building strategies since temperature problems have been detected in the Pysht River.

Hoko River Subbasin

Increase Efficiency of Existing Water System

The Clallam Bay/Sekiu water system relies on the Hoko River for its water supply. Improving the efficiency of the system could reduce water demand on the Hoko River. Current loss estimates vary from

14 to 24 percent, with an average loss of approximately 20 percent (Kitz, 2005). The water district is currently addressing conservation methods as well as implementing measures to reduce water losses.

CHAPTER 5.
EVALUATION AND RECOMMENDATIONS

This chapter describes the evaluation of the projects described in Chapters 3 and 4 and the selection of preferred projects.

EVALUATION PROCESS

Initial Screening

Based on an initial qualitative assessment, the following groups of projects were determined to be unsuitable and were eliminated from further evaluation; no cost estimates or conceptual project designs were developed for these projects:

- **Aquifer storage and recovery—**Given the extensive infrastructure needed for ASR projects, the relatively low population density of the watershed, and the lack of evidence of a suitable aquifer, ASR was determined to be unsuitable for water storage in WRIA 19 at this time. Future consideration of an ASR project would require further investigation to document the extent, type, and capacity of WRIA 19's aquifers.
- **Surface water storage:**
  - **To augment stream flows**—While water storage for stream flow augmentation is simple in concept, a water storage project would require significant additional infrastructure to provide a measurable increase in summer stream flows. The amount of storage required would be quite large. Providing a 1-cfs increase in flow for a period of one month would require a volume of approximately 60 acre-feet, or 19 million gallons. Storage costs would likely be on the order of $1 per gallon. The benefit of such a project likely would not warrant the cost of construction. For the cost, restoration projects would likely provide more benefits. Small projects to control runoff may be warranted by benefits other than those related to storage; however, their benefit to stream flows alone is too limited to justify their expense, so they are not recommended in this report.
  - **To meet domestic water demand**—Water storage projects to meet domestic demand are feasible, but do not seem necessary. Forecasts indicate that the major water providers in WRIA 19 have existing capacity to meet demand for the next 20 years. While storage of winter water for summer consumption is feasible, it would be problematic for cost, water quality and aesthetic concerns. Therefore, no further evaluation was done to determine locations or sizes of potential surface water storage projects. More cost-effective approaches to meeting water demand are the nonstructural alternatives of improving system efficiency and promoting water conservation. For new developments, the nonstructural alternative of mitigation for new water rights is recommended.

Because the nonstructural projects represent good watershed management policy, all of them are recommended. Therefore, no further evaluation or comparison was done. Table 5-1 summarizes the results of the initial screening process. One project, the bank erosion and flooding study in the Pysht subbasin, is currently in progress and is therefore not evaluated or included in the recommendations.

TABLE 5-1.
RESULTS OF INITIAL SCREENING OF ALTERNATIVES

Project	Structural Type[a]	Nonstructural Type[b]	Retained for Further Evaluation?
Salt Creek Subbasin			
Projects to Control Runoff	SWS	—	**No**
Abandon Camp Hayden Spur Road	NFS	—	Yes
Aquifer Storage and Recover	ASR	—	**No**
Treatment of Channel Incision at RM 2.0 – 4.0	SR	—	Yes
Stop Unauthorized Water Withdrawals	—	LS	Yes
Lyre River/Lake Crescent Subbasins			
Water Supply Storage	SWS	—	**No**
Restore the Lowest Mile of Lyre River	SR	—	Yes
Increase Efficiency of Existing Water System	—	LS	Yes
Coordination Between Lyre River and Lake Crescent Subbasins	—	LS	Yes
Twin Rivers Subbasin			
Logjams/Wetland Restoration	NFS	—	Yes
Source Protection Study	—	LS	Yes
Deep Creek Subbasin			
Remedy Channel Incision	SR	—	Yes
Pysht River Subbasin			
Restore Wetlands and Floodplain Connectivity	NFS	—	Yes
Bank Erosion and Flooding Study	—	LS	**No**
Clallam River Subbasin			
Projects to Control Runoff	SWS	—	**No**
Aquifer Storage and Recover	ASR	—	**No**
Promote the Use of Reclaimed Water	SUP	—	Yes
Hoko River Subbasin			
Water Supply Storage	SWS	—	**No**
Hoko River Habitat Restoration (5900 Road near Ellis Creek)	SR	—	Yes
Hoko River Riparian Restoration (Lower Hoko River on Cowan Ranch)	SR	—	Yes
Increase Efficiency of Existing Water System	—	LS	Yes

a. SWS = surface water storage; NFS = natural floodplain storage; ASR = aquifer storage and recover; SR = stream restoration; SUP = supplemental water supply
b. WW= WRIA-wide; LS = location-specific

TABLE 5-1 (continued).
RESULTS OF INITIAL SCREENING OF ALTERNATIVES

Project	Structural/Type[a]	Nonstructural/ Type[b]	Retained for Further Evaluation?
WRIA-Wide			
Promote Maintenance of Lands in Forest Management	—	WW	Yes
Encourage Low-Impact Development	—	WW	Yes
Promote Water Conservation Policies/Projects	—	WW	Yes
Re-establish Beaver Populations	—	WW	Yes
Forest Practices Information and Communication Forums	—	WW	Yes
Implement Road Maintenance and Abandonment Programs	—	WW	Yes
Complete a Comprehensive Wetland Inventory	—	WW	Yes
Complete a Stream Walk Inventory	—	WW	Yes
Mitigation for New Water Rights	—	WW	Yes

a. SWS = surface water storage; NFS = natural floodplain storage; ASR = aquifer storage and recover; SR = stream restoration; SUP = supplemental water supply
b. WW= WRIA-wide; LS = location-specific

Assessment of Screened Alternatives

All alternatives remaining after the initial screening were determined to be technically feasible and to provide water storage benefit to WRIA 19. Preliminary cost estimates were developed for these projects , the amount of storage provided by each was estimated, and each was given a rating based on the rating system described below.

Cost Estimate

Many of the details that are necessary to provide an estimate of project costs are not yet available. Therefore, cost estimates for the proposed projects are conceptual and represent an order of magnitude for project costs. In addition, some of the proposed structural projects include multiple projects (e.g., wetland restoration in the Twin Rivers Subbasin); cost estimates for these projects are cumulative and reflect all of the proposed projects. Cost estimates will be refined in the final storage plan. Table 5-2 summarizes estimated costs.

Water Storage Estimate

The water storage benefit from wetland and stream restoration projects is difficult to quantify, but their aim is to restore the natural hydrologic regime and they provide significant habitat and other benefits. For these projects, a detailed study that would quantify the relationship between infiltration, groundwater storage and surface water base flows would be needed to properly evaluate the water storage potential. This would largely be an academic exercise and is not necessarily recommended unless opportunities to endorse or fund a project are available. For this report, a qualitative rating of each project's water storage benefit was made. This estimate is based on the type of project and its location within the watershed—projects located higher in the watershed were given a higher score since any benefits would be seen downstream.

TABLE 5-2.
ESTIMATED PROJECT COSTS FOR SCREENED ALTERNATIVES

Project	Estimated Project Cost
Salt Creek Subbasin	
Abandon Camp Hayden Spur Road	$1,000,000
Treatment of Channel Incision at RM 2.0 – 4.0	$800,000
Stop Unauthorized Water Withdrawals	$85,000
Lyre River/Lake Crescent Subbasins	
Restore the Lowest Mile of Lyre River	$1,000,000
Increase Efficiency of Existing Water System	$200,000
Coordination Between Lyre River and Lake Crescent Subbasins	$40,000
Twin Rivers Subbasin	
Logjams/Wetland Restoration	$4,000,000[a]
Source Protection Study	$100,000
Deep Creek Subbasin	
Remedy Channel Incision	$500,000
Pysht River Subbasin	
Restore Wetlands and Floodplain Connectivity	$4,000,000[a]
Clallam River Subbasin	
Promote the Use of Reclaimed Water	$200,000
Hoko River Subbasin	
Hoko River Habitat Restoration (5900 Road near Ellis Creek)	$750,000
Hoko River Riparian Restoration (Lower Hoko River on Cowan Ranch)	$600,000
Increase Efficiency of Existing Water System	$200,000
WRIA-Wide	
Promote Maintenance of Lands in Forest Management	$200,000
Encourage Low-Impact Development	$150,000
Promote Water Conservation Policies/Projects	$150,000
Re-establish Beaver Populations	$150,000
Forest Practices Information and Communication Forums	$150,000
Implement Road Maintenance and Abandonment Programs	$300,000
Complete a Comprehensive Wetland Inventory	$300,000
Complete a Stream Walk Inventory	$150,000
Mitigation for New Water Rights	$200,000

a. Cost shown is total cost for projects at multiple locations.

Nonstructural projects deal primarily with policies that are aimed at restoring the natural hydrologic regime. Since they are largely general policy programs, their water storage benefits are difficult to

quantify and will depend on how the policies are implemented. As a result, water storage volume was not estimated for the nonstructural projects.

Project Rating

Structural projects and location-specific nonstructural projects were given a rating from 0 to 10 for the following categories: water storage potential, environmental benefits, estimated project cost, and the identified need for storage within that subbasin. This rating allows comparison of the relative merits of each project. Projects ratings are contained in Table 5-3. Ratings were not developed for WRIA-wide nonstructural projects, since all of these were recommended in the initial screening process.

TABLE 5-3.
RATINGS FOR SCREENED STRUCTURAL AND
LOCATION-SPECIFIC NONSTRUCTURAL ALTERNATIVES

Project	Water Storage	Environmental Benefit	Estimated Cost	Subbasin Need	**Total**
Salt Creek Subbasin					
Abandon Camp Hayden Spur Road	4	8	5	10	**27**
Treatment of Channel Incision at RM 2.0 – 4.0	3	7	5	10	**25**
Stop Unauthorized Water Withdrawals	7	7	9	10	**33**
Lyre River/Lake Crescent Subbasins					
Restore the Lowest Mile of Lyre River	2	7	7	6	**22**
Increase Efficiency of Existing Water System	8	0	8	10	**26**
Coordination Between Lyre River and Lake Crescent Subbasins	2	5	9	5	**21**
Twin Rivers Subbasin					
Logjams/Wetland Restoration	4	8	6	8	**26**
Source Protection Study	7	7	7	6	**27**
Deep Creek Subbasin					
Remedy Channel Incision	4	9	5	7	**25**
Pysht River Subbasin					
Restore Wetlands and Floodplain Connectivity	4	7	6	7	**24**
Clallam River Subbasin					
Reclaimed Water	4	2	3	7	**16**
Hoko River Subbasin					
Hoko River Habitat Restoration (5900 Road near Ellis Creek)	3	9	7	5	**24**
Hoko River Riparian Restoration (Lower Hoko River on Cowan Ranch)	3	9	7	5	**24**
Increase Efficiency of Existing Water System	7	0	8	10	**25**

RECOMMENDATIONS

Table 5-4 summarizes the projects recommended for further investigation or implementation. Most of the natural floodplain storage and stream restoration projects are not recommended based on this study because their water storage benefit cannot be shown to warrant their costs. However, these projects provide many benefits other than water storage, and it may be appropriate to implement them for these other benefits, or if their water storage benefit can be better quantified. A general program of wetland restoration is strongly recommended. If money becomes available, restoration projects that expand wet areas or reconnect the floodplain should be given additional weight. Further investigation is needed to quantify the effects of wetlands and infiltration programs on surface water quantities. Wetland projects listed in this report were based on a survey of existing information that focused on a small portion of the watershed; there may be opportunities for many other wetland projects in the watershed.

All of the recommended projects will require additional detailed feasibility assessment if pursued. In general, an emphasis was placed on the nonstructural projects, which address the watershed's storage needs on a basic level and are more cost-effective than structural solutions. The following are key considerations related to the recommended projects:

- **Salt Creek; Abandon Camp Hayden Spur Road**—The water storage benefits for this project are difficult to quantify, but are likely to be low given the position of the project in the lower portion of the subbasin. However, this project has been identified as the second highest priority for habitat restoration by the Lower Elwha Klallam Tribe. Given the high priority of this project by the stakeholders, it is recommended. This project has been submitted for a BIA grant.
- **Salt Creek; Stop Unauthorized Water Withdrawals**—Reducing illegal water withdrawals from surface water sources in the subbasin would shift use of the subbasin's water resources to exempt groundwater wells and the Crescent Water Association supply. This could reduce impacts on surface water features in the subbasin. Shifting water usage to CWA also would increase CWA revenue, helping the district to fund additional water storage or efficiency projects.
- **Lyre River/Lake Crescent; Increase Efficiency of Existing Water System**—Increasing the efficiency of the water infrastructure would likely have the most tangible benefit for water resources in the Lyre Subbasin. This recommendation provides a direct storage benefit, meets a clearly defined subbasin need, and is cost-effective; these advantages make it favorable even though it provides no direct environmental benefit (as indicated by its "0" rating for environmental benefit in Table 5-3). The CWA has already taken steps to address system efficiency. Reducing waste and conserving water remain the most cost-effective ways to reduce demand on the subbasin's water resources. CWA efficiency measures also will benefit the Salt Creek Subbasin, which is also served by the CWA system.
- **Lyre River/Lake Crescent; Coordination Between Lyre River and Lake Crescent Subbasins**—Although this project does not specifically deal with water storage issues, the relationship between Lake Crescent and the Lyre River should be documented and included in future National Park Service planning.

TABLE 5-4.
RECOMMENDED ALTERNATIVES

Project	Project Type[a]	Estimated Cost	Project Rating
Salt Creek Subbasin			
Abandon Camp Hayden Spur Road	NFS	$1,000,000	27
Stop Unauthorized Water Withdrawals	LS	$85,000	33
Lyre River/Lake Crescent Subbasins			
Increase Efficiency of Existing Water System	LS	$200,000	26
Coordination Between Lyre River and Lake Crescent Subbasins	LS	$40,000	21
Twin Rivers Subbasin			
Source Protection Study	LS	$100,000	27
Clallam River			
Reclaimed Water	SUP	$300,000	27
WRIA-Wide			
Promote Maintenance of Lands in Forest Management	WW	$200,000	—
Encourage Low-Impact Development	WW	$150,000	—
Promote Water Conservation Policies/Projects	WW	$150,000	—
Re-establish Beaver Populations	WW	$150,000	—
Forest Practices Information and Communication Forums	WW	$150,000	—
Implement Road Maintenance and Abandonment Programs	WW	$300,000	—
Complete a Comprehensive Wetland Inventory	WW	$300,000	—
Complete a Stream Walk Inventory	WW	$150,000	—
Mitigation for New Water Rights	WW	$200,000	—

a. NFS = Structural natural floodplain storage; WW= Nonstructural WRIA-wide; LS = Nonstructural location-specific; SUP = Supplemental water supply

- **Twin Rivers; Source Protection Study**—According to available information, the springs that feed the Twin Rivers play a significant role in maintaining the rivers' base flows. Documenting the spring locations and recharge area would not specifically provide storage or increase base flows, but establishing protections for existing sources could eliminate the need for future more expensive mitigation projects.

- **WRIA-Wide; Promote Maintenance of Lands in Forest Management** —Since historical records indicate that the vast majority of the watershed was originally forested, a continuing emphasis on forest conservation is recommended. An advanced study is needed to quantify the relationship between forest cover, infiltration, groundwater, and surface water. By quantifying the effects of forest harvesting on base flows, new regulations can be fairly developed and administered or proper mitigation can be specified.

- **WRIA-Wide; Encourage Low-Impact Development**—LID could reduce the impact of future development in the watershed. In existing developments, steps can be taken to minimize the amount of impervious surface that is directly connected to the storm drain network. The recommended project is a public information program that would include information on the effects of impervious area, explain how individuals can mitigate these effects, and indicate how development costs might be reduced by implementing LID. The program could also include information on the benefits of a policy of LID for new development in the watershed. A model ordinance could be developed and adopted. Although the benefit of this project is not likely to be felt in the near future, it is recommended because it is an inexpensive way to prevent problems that could arise with future development. The estimated five-year cost of this project is $150,000.
- **WRIA-Wide; Promote Water Conservation Policies/Projects**—Reducing water consumption by increasing awareness of the limited availability of water supply and promoting conservation remains the most cost-effective way to reduce the impact of water withdrawals. Reducing the per capita consumption rate of water customers extends the life of existing water supply rights. This project re-emphasizes the continuing efforts of the WRIA's water providers to promote water use efficiency and conservation.
- **WRIA-Wide; Re-establish Beaver Populations**—The recommended action is to establish a public information program that will explain the beneficial effects that beavers have on ecosystems and encourage landowners not to automatically remove beavers from their properties. Establishing a program to relocate nuisance beavers is also a recommended priority. It is not recommended at this time to set up a program to actively reintroduce beavers to areas in the watershed. This is a long-term solution that would not provide immediate or quantifiable results. It is based on the premise that if portions of the watershed can be restored to their natural condition, then ultimately the consequence of this restoration would be a more natural hydrologic regime that would promote instream flows. The estimated five-year cost of this project is $150,000. As with other projects that focus on improving base flow through groundwater recharge, an additional study should be commissioned to quantify the relationship between infiltration, groundwater, and surface water.
- **WRIA-Wide; Forest Practices Information and Communication Forums**—Because forest practices dominate the land use activities within WRIA 19, watershed impacts from these activities have potential to affect the natural water storage. This recommended action is to establish communication and information dissemination mechanisms (such as email notification and information sharing meetings) to promote stakeholder knowledge and input about forest management policies, programs, and activities.
- **WRIA-Wide; Implement Road Maintenance and Abandonment Programs**—Roads can disrupt natural drainage patterns and diminish the natural water storage within a watershed. Private and state forest landowners are currently developing and implementing road abandonment plans to decrease the density of forest roads, and bring remaining roads to higher standards. These efforts are very important, and where such efforts can be accelerated, possibly through financial assistance or partnerships, those actions are recommended by this study.
- **WRIA-Wide; Complete a Comprehensive Wetland Inventory**—Restoring or maintaining natural hydrologic processes is a key element in the WRIA's capacity to store water and maintain summer base flows. A comprehensive survey of existing and

historical wetlands is needed to allow for better identification of future water storage projects. Such a survey will provide valuable information for future planning; and public involvement in the inventories can enhance community understanding and appreciation of water resources in the watershed.

- **WRIA-Wide; Complete a Stream Walk Inventory—**A complete survey of each stream in WRIA 19 can help provide a holistic picture of the watershed. Stream walk surveys are ideal for community participation. They provide valuable information for future planning; and public involvement in the stream walks can enhance community understanding and appreciation of water resources in the watershed.

These recommendations are based on evaluation of currently available information. With new data collection and analysis in the future, additional structural and nonstructural measures may be identified for maintaining or enhancing WRIA 19 stream flows or domestic water supply through a variety of storage approaches. Following the general concept of adaptive management, the Planning Unit should stay informed about relevant future studies, and future updates to the Watershed Plan should endorse storage activities when warranted based on their estimated benefits and costs. In particular, Planning Unit members have identified the following areas where storage-related efforts should be considered:

- The upper reaches of Salt Creek may contain areas that are feasible sites for off-channel storage facilities. Public agencies may be able to work with landowners in this area to identify cost-effective ways to increase storage in the upper Salt Creek Subbasin. In other subbasins, wetland enhancements may be appropriate along the upper reaches to enhance stream flows.
- Stream reaches throughout the Salt Creek Subbasin are deficient in large woody debris, and opportunities to increase LWD in these areas should be pursued when feasible.
- Development can have significant impacts on hydrology in the Clallam River Subbasin, and small projects to mitigate for these impacts should be pursued.
- Opportunities for improvements in the Sekiu River Subbasin should be considered, in cooperation with ongoing Makah Tribe activities or as identified by any future studies.

ACTION PLAN

An action plan will organize the recommended alternatives in groups to define the most appropriate order for implementing them. Creating an action plan requires a range of questions to be answered for each recommendation. These include the following:

- Does the recommendation require the completion of another recommendation before it can be implemented?
- Is the recommendation subject to time constraint considerations, such that it needs to be completed by a certain time, or should not be completed until after a certain time?
- What group, agency or team should be responsible for the implementation of the recommendation?
- What are the available and most appropriate sources of funding to pay for implementing the recommendation?
- Does the recommendation address a specific existing problem or is it a proactive measure to prevent future problems?

- Are there advantages to implementing the recommendation in phases over time rather than all at once?
- Can the recommendation be implemented concurrently with other recommendations to improve efficiency and reduce cost or effort?

Based on the answers to these and other questions, each recommendation can be assigned a rating that will define when it should be implemented. The categories may be based on priority (high, medium and low) or timeframe (short-term, medium-term and long-term). Table 5-5 summarizes factors to consider in reviewing each recommendation for implementation, based on comments from the Planning Unit meeting at which this report was discussed.

Although a detailed action plan was not developed for this study, the recommendations were reviewed to determine those that should be implemented soonest and to identify factors that will affect their implementation ratings. There are many potential projects within the WRIA that are not discussed in this report, and new information and data are needed to identify projects and prioritize them. Because of this need for further data, the projects that should be given the highest priority are the stream walk inventory and wetland inventory.

SUMMARY

The main findings of the water storage study are as follows:

- More information and documentation of the water storage needs of the watershed is needed. There is currently limited information on the number and quality of existing and historical wetlands as well as potential stream restoration projects. In addition, more information is needed to quantify the causes of water deficiencies in the watershed, in order to facilitate mitigation and project planning.
- Large engineered water storage projects are not recommended at this time due to their low benefit/cost ratio. Adopting programs and polices that emphasize restoration of natural hydrologic processes and water conservation provide the most cost-effective way to reduce water resources impacts.
- Most of the recommended projects contained in this report have a strong emphasis on public information. Water is consumed by everyone in the watershed for a variety of uses, and most of the limiting factors stem from current land use practices and attitudes toward water consumption. Residents often do not know that simple changes in how drainage and water use is perceived can have positive impacts on water supply and instream flows. Given the increasing difficulty in developing new water supply projects, the most logical place to begin is to make people aware that a problem with instream flows exist and to explain how the hydrology of the watershed works. People can then more easily make the connection between how traditional views of consumption and drainage may impact the watershed's hydrology, and they may be more open to adopting solutions for the future.

TABLE 5-5.
CONSIDERATIONS FOR DEVELOPING AN ACTION PLAN FOR RECOMMENDED ALTERNATIVES

Project	Issues to Consider in Developing Priority Ranking
Complete a Comprehensive Wetland Inventory	• Funding must be identified • Governing or organizing entity must be decided • This project is critical in collecting the information needed to identify and prioritize wetland and stream restoration projects as well as other structural projects.
Complete a Stream Walk Inventory	• Funding must be identified • Governing or organizing entity must be decided • This project is critical in collecting the information needed to identify and prioritize wetland and stream restoration projects as well as other structural projects.
Abandon Camp Hayden Spur Road	• Funding must be verified • Lower Elwha Klallam Tribe has identified this project as a priority. • This project has been submitted for a BIA grant.
Twin Rivers Source Protection Study	• Funding must be identified • Governing or organizing entity must be decided • This project can be implemented immediately as soon as funding is identified.
Increase Efficiency of Existing Water Systems	• Implementation depends on funding and prioritizing within the CWA and Clallam PUD #1 water districts. • This project is currently being implemented by the CWA and Clallam County PUD #1.
Coordination Between Lyre River and Lake Crescent Subbasins	• Funding must be identified • This project can be implemented immediately as soon as funding is identified.
Forest Practices Information and Communication Forums	• Funding must be identified • This project can be implemented immediately as soon as funding is identified
Implement Road Maintenance and Abandonment Programs	• Ongoing program • Project is included to emphasize importance of existing rules and to highlight the effect roads have on water storage.
Stop Unauthorized Water Withdrawals in Salt Creek	• Funding must be identified • The stream walk inventory should be completed first. • The stream walk inventory should be completed first, in order to identify illegal water withdrawals in the WRIA.
Promote Water Conservation Policies/Projects	• Information on conservation is currently distributed by water service providers. • Additional funding for increased promotion must be identified • This project should be coordinated through Clallam County and the water service providers in the WRIA.
Clallam River Reclaimed Water	• Feasibility study must be completed • Project must be coordinated with Clallam Bay Correctional Facility • Funding source must be identified • Considerable further investigation is required before this project can be implemented.

TABLE 5-5 (continued).
CONSIDERATIONS FOR DEVELOPING AN ACTION PLAN FOR RECOMMENDED ALTERNATIVES

Project	Issues to Consider in Developing Priority Ranking
Encourage Low-Impact Development	• Funding source must be identified • Project should be promoted through Clallam County
Reestablish Beaver Populations	• Funding source must be identified • Areas targeted for reintroduction must be identified
Promote Maintenance of Lands in Forest Management	• Ongoing process • Project is included to emphasize importance of existing rules and to highlight the effect forests have on water storage
Mitigation for New Water Rights	• Funding source must be identified • This project is essentially a political process to try to outline procedures for establishing future water rights.
General Wetland Restoration Projects	• Funding source must be identified • Projects will be identified and prioritized based on the results of wetland inventory. • The wetland inventory should be completed first, in order to identify illegal water withdrawals in the WRIA
General Stream Restoration Projects	• Funding source must be identified • Projects will be identified and prioritized based on the results of stream walk survey. • The stream walk inventory should be completed first, in order to identify potential projects

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