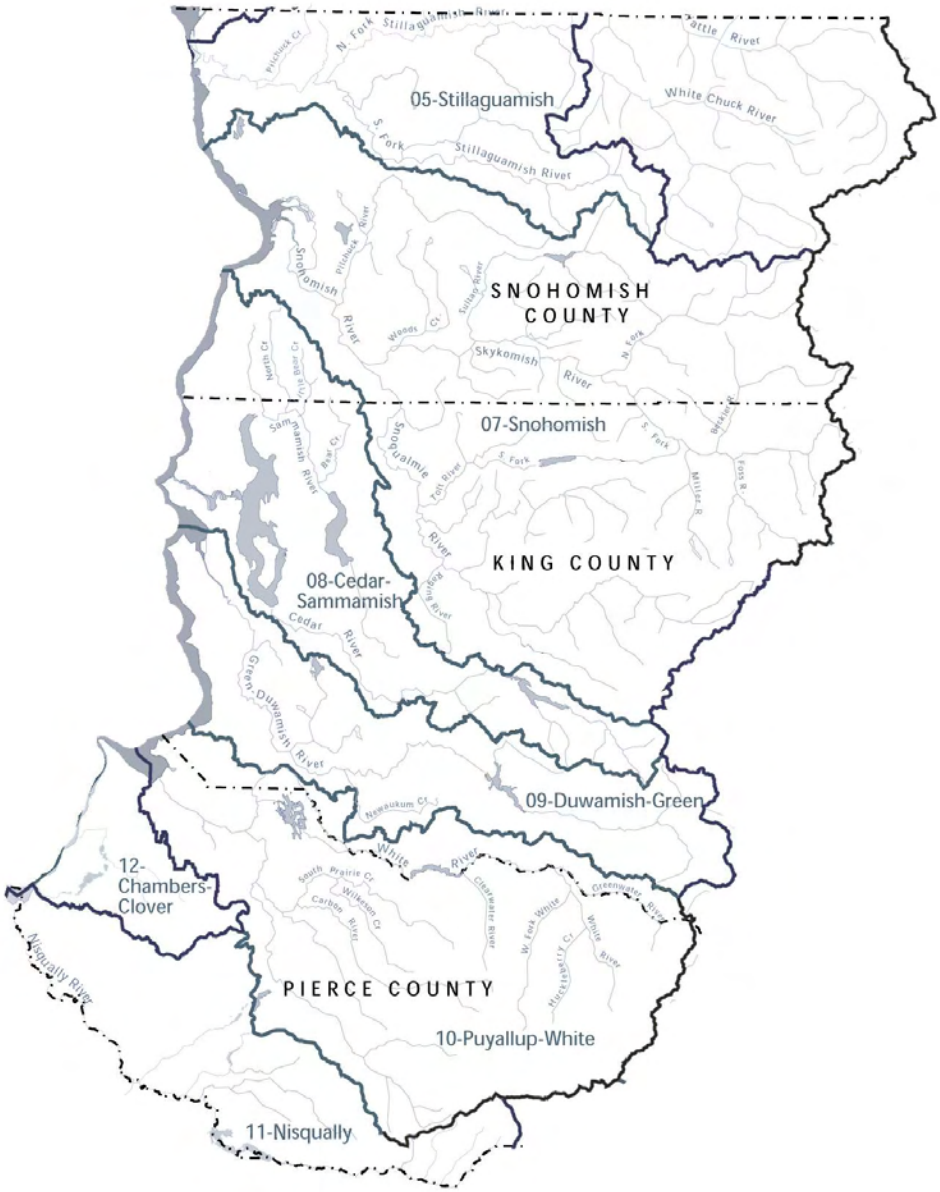
Biological Review
Tri-County Model 4(d) Rule Response Proposal

Prepared for:

Tri-County Salmon Conservation Coalition



Parametrix

April 2002

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Prepared for

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April 19, 2002

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ACRONYMS

BAO	Built Area Option
BCE	bankfull channel edge
BMP	Best Management Practices
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CIP	Capital Improvement Program
CMZ	Channel Migration Zone
CWA	Clean Water Act
cy	cubic yard
DNR	Department of Natural Sciences
DO	dissolved oxygen
DPS	Distinct Population Segment
Ecology	Washington State Department of Ecology
EDT	Ecosystem Diagnosis and Treatment
EIA	effective impervious area
ESA	Endangered Species Act
EPA	Environmental Policy Act
ESU	evolutionarily significant unit
ET	evapotranspiration
FEMAT	Forest Ecosystem Management Assessment Team
ft	foot/feet
GIS	Geographic Information System
GMA	Washington State Growth Management Act
HCP	Habitat Conservation Plan
HMP	habitat management plan
IMZ	inner management zone
km	kilometer
LFA	Limiting Factors Analysis
LSOG	Late successful old-growth retention
m	meter
mi	miles
mm	millimeter
Model	Tri-County Model 4(d) Rule Response Proposal
MPI	Matrix of Pathways and Indicators
MRCI	municipal, residential, commercial, and industrial

ACRONYMS (CONTINUED)

MTCA	Model Toxic Cleanup Act
MZ	Management Zone
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRDA	Natural Resources Damage Assessment
NTU	Nephalometric turbidity unit
OMZ	outer management zone
OPA	Oil Pollution Act
PFC	properly functioning habitat conditions
RCRA	Resource Conservation and Recovery Act
RM	river mile
ROW	right-of-way
SCS	Soil Conservation Service
SEPA	State Environmental Protection Agency
Services	NMFS and the USFWS
sf	square feet
Shared Strategy	Puget Sound Shared Salmon Strategy
SMA	Shoreline Management Act
SPTH	site potential tree height
SRFB	Salmon Recovery Funding Board
TESC	temporary erosion and sedimentation controls
TIA	total impervious area
TR	total recoverable
Tri-County region	Snohomish, King, and Pierce counties
TSS	total suspended solids
UGA	urban growth area
USFWS	United States Fish and Wildlife Service
WA DNR	Washington Department of Natural Resources
WDFW	Washington Department of Fish and Wildlife
WRIA	Watershed Resource Inventory Area
WRIA planning	Watershed Based Salmonid Conservation Planning
WSCC	Washington State Conservation Commission
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

The listings of the Puget Sound chinook salmon (*Oncorhynchus tschawytscha*) and Coastal Puget Sound distinct population segment (DPS) of bull trout (*Salvelinus confluentus*) as threatened species under the Endangered Species Act (ESA) requires governmental entities to develop actions to protect chinook salmon and bull trout habitat. Snohomish, Pierce, and King Counties, together with Tribal and business entities, have developed a Tri-County Model 4(d) Rule Response Proposal (Model) (May 18, 2001) as part of their actions to protect and recover the species.

Parametrix, Inc. was retained by the Tri-County group to conduct third party evaluation of the effects this Model is likely to have on the habitat supporting chinook salmon and bull trout. This analysis was conducted with reference to the 4(d) Rule issued by the National Marine Fisheries Service (NMFS) for chinook salmon, and the potential promulgation of a "special 4(d) rule" for bull trout that may be issued by the United States Fish and Wildlife Service (USFWS). The biological review is addressed in eight chapters, which are summarized below.

Chapter 1 of this biological review provides background on the ESA listings of chinook salmon and bull trout in the Puget Sound region. It presents a review of the ESA 4 (d) Rule formulation process. The NMFS adopted a detailed 4(d) Rule in July 2000 to prohibit the take of Puget Sound chinook salmon, listed as *threatened* under the ESA (along with 13 other groups of salmon and steelhead). The NMFS 4(d) Rule includes 13 take limits. Through these take limits, NMFS identified various activities that may be sufficiently regulated to provide for the needs of listed species. The NMFS 4 (d) Rule and the USFWS special rule, together with recovery planning and Tribal treaty rights, are reviewed in Chapter 1.

The USFWS has an alternative process that promulgates a detailed 4(d) Rule for threatened species. The NMFS and USFWS (Services) issue a special 4(d) Rule if they determine such action is appropriate to eliminate or reduce the take of a listed species. The USFWS published a "special rule" for bull trout on November 1, 1999, in the Federal Register (Volume 64, Number 210, pages 58909-58933) that exempts certain fishing programs, educational programs, and scientific activities from the bull trout take prohibition. The USFWS also published a Notice of Intent to prepare a proposed special rule for bull trout (Federal Register Vol. 64, No. 210, p. 58934-58936). This notice indicates that the USFWS is considering whether to amend the existing special rule to exempt two additional categories of other activities that may affect bull trout: habitat restoration, as well as other land and water management activities governed by regulations that provide substantial protection for bull trout.

Recovery Planning for chinook salmon and bull trout in the Puget Sound region is following a unique collaborative process called the Puget Sound Shared Salmon Strategy (Shared Strategy). The Shared Strategy is working to coordinate watershed and regional planning efforts that culminate in a program that can return salmon stocks throughout Puget Sound to sustainable and harvestable levels. The NMFS and USFWS are obliged to ensure that their actions are in accordance with their trust responsibilities for Tribal rights guaranteed in various treaties signed with the United States government. The Model is not a recovery plan, but will assist jurisdictions in complying with the NMFS 4(d) rule. The Model contains two aspects important to recovery planning:

- The early action programs are intended to avoid or minimize further harm to habitat.
- The long-term action programs directly support recovery planning efforts in Puget Sound.

The Model provides options for local jurisdictions to contribute to the conservation of listed salmonids and potentially obtain coverage under the 4(d) Rule issued by NMFS or any special rule for bull trout that the USFWS may promulgate in the future.

The Model includes three early action programs and three long-term action programs that may be implemented by local jurisdictions as described below. The overall goal of the Tri-County Salmon Conservation Coalition effort is to "recover Puget Sound chinook salmon and other listed salmonids without undermining the region's economy." (Tri-County 1998). The strategy for achieving this goal is described.

This biological review of the Model was conducted to determine whether the Model would contributes to the persistence of existing habitat functions and the restoration of additional habitat functions sufficient to support sustainable, harvestable salmonid populations. It also evaluates if the Model conserves listed salmonid species consistent with the ESA and the NMFS 4(d) Rule for threatened salmonids.

Tri-County jurisdictions can use information presented in this biological review in several ways:

- Use the Model and results of the biological review to pursue formal coverage under the ESA (a take limit under the NMFS 4(d) rule), or a reduction/elimination of take prohibition under a future USFWS special rule.
- Apply the Model (in whole or in part) using best available science (without formal coverage under ESA) using Washington State Growth Management Act and federal Clean Water Act authorities.

Chapter 2 of this biological review describes the early-action and long-term programs of the Tri-County Model 4(d) Rule Response Proposal and its Ecological Framework. The Model includes early- and long-term action programs developed to avoid further harm to chinook salmon and bull trout. Early action programs would be implemented immediately upon adoption and would begin to produce effects almost immediately. The long-term programs most likely would begin immediately upon adoption, but their effects on habitat are likely to be produced over the long term rather than immediately.

Early action programs include the following:

- Land Management Program
- Stormwater Management Program
- Regional Road Maintenance ESA Program Guidelines.

The Model also includes three long-term action programs:

- Watershed Based Salmonid Conservation Planning Program (WRIA Based Planning)
- Monitoring and Adaptive Management Program
- Habitat Acquisition and Restoration Funding Program

The **Land Management Program** includes a planning element that would ensure counties and cities consider chinook salmon and bull trout habitat protections when making land use decisions under the Washington State Growth Management Act (GMA; Chapter 36.70A RCW). The Land Management Program is designed to serve as a model from which individual jurisdictions can in part construct their own proposals for a take limit. It includes a regulatory element that provides specific protections for salmonid habitat from development impacts when implemented through various regulatory tools already available to local government (such as critical areas ordinances; shoreline master programs; Class IV forest practices permits; clearing, grading, and stormwater ordinances; etc.). The regulations focus on protecting riparian habitat within the management zone (MZ). The program includes provisions for inner and outer management zones for rural and urban areas.

The **Stormwater Management Program** is a comprehensive, integrated program of planning, regulation, land use, capital projects, and education designed to better protect and restore chinook salmon and bull trout habitat from the stormwater-related impacts of past and future development. It is designed to meet both ESA and Clean Water Act objectives. This program addresses the potential impacts associated with new development and construction of new stormwater discharges. The Model requires that stormwater facilities be designed to match the discharge durations for the site condition that existed prior to any development in the Puget Sound region assuming the site was forested (or other native condition). The Stormwater Management Program provides that a minimum of 65% will be retained as natural forested vegetation for development on rural residential sites, and impervious surface area will not exceed 10%. For sites where less than 65% of forest cover remains, the Model requires that remaining forest be retained, while subdivisions are required to reforest to the 65% level. Some individual site development may, however, have new effective impervious area limits below the threshold for requiring flow controls. These sites must still disperse and infiltrate stormwater to the maximum extent practicable. The Model does not require impervious area and forest clearing limits for urban sub-basins with listed species.

The **Regional Road Maintenance ESA Program Guidelines** provide road maintenance practices that would achieve conservation outcomes consistent with the NMFS ESA 4(d) Rules, limit 10. The program emphasizes an outcome-based approach and relies on best management practices (BMPs) that are designed to provide erosion and sedimentation control by minimizing soil exposure, stabilizing disturbed areas, minimizing runoff, and retaining sediment. The Regional Road Maintenance Program is reviewed in a separate biological review and it is incorporated herein by reference.

The **WRIA Based Planning Program** is a comprehensive, ecosystem-based program to develop, implement, and monitor actions that are intended to improve habitat conditions for salmonids. It includes a planning element to monitor salmonid conservation results in each watershed and help coordinate adaptive management decisions through Watershed Resource Inventory Area (WRIA) planning processes. A stated purpose of WRIA planning is to advance the Tri-County goal of recovering salmonid species to sustainable, harvestable population levels.

The **Monitoring and Adaptive Management Program** involves a long-term commitment to monitor outcomes, evaluate successes and failures, and recommend needed course corrections. Monitoring supports the adaptive management strategy of the Model by providing compliance monitoring, effectiveness monitoring, and validation/recovery monitoring. There are planning, monitoring and adaptive management elements within the individual early action programs that overlap with the Monitoring and Adaptive Management program.

The **Habitat Acquisition and Restoration Funding Program** would augment regulations by providing funding for habitat acquisition and restoration to ensure that critical spawning, rearing, and migration corridor habitats are available. The program requires a commitment from each participating jurisdiction to annually dedicate at least 1% of its capital budget to habitat acquisition and/or capital projects with habitat benefits for salmonids.

The Model acknowledges the diverse circumstances of many large and small jurisdictions and strives to conserve all salmonids by attempting to protect habitat of value to multiple salmonid species, with an emphasis on listed species. Each program of the Model is based on an ecological framework tailored by subject matter. The framework of each program is discussed in Chapter 2 and evaluated in Chapter 4

Chapter 3 provides an overview of the assessment methodologies. It presents definitions of terms and assumptions used throughout the biological review to evaluate the Model and describes general methods of analysis used in this biological review. Details of specific methodologies are provided in subsequent chapters.

The Parametrix biological review of the Tri-County Model involves several different types of analyses. We (1) evaluated the consistency of the Model with Federal guidance and scientific literature, (2) assessed the effect of the model on specific sub-basins, (3) identified the effects of independently implementing individual Model programs, and (4) evaluated the synergistic effects of the complete Model.

Chapter 4 provides our evaluation of the consistency of the Model with federal guidance and scientific literature which form the ecological foundation for developing the Tri-County Model. This evaluation first considers the consistency of Model programs with the habitat objectives that NMFS considers essential elements of a comprehensive framework to maintain and restore ecosystem processes and functions (NMFS 1996). It next considers consistency with available USFWS guidance and literature identifying bull trout habitat characteristics. Finally, Chapter 4 presents the evaluation of the technical and programmatic concepts supporting each of the main elements of the Model programs.

Model programs are compared to best available science. Each of the individual elements of the early action programs are evaluated using the guidance developed by NMFS for salmon conservation planning provided in the Coastal Salmon Conservation: Working Guidance for Comprehensive Salmon Restoration Initiatives on the Pacific Coast (NMFS 1996). This guidance identifies five habitat objectives as essential elements of a comprehensive framework to maintain and restore appropriate ecosystem processes and functions. The USFWS has not yet formulated a special rule for development activities, but has provided information in the USFWS Interim Conservation Guidance (USFWS 1998c) and other publications to evaluate the potential effects of the Model on bull trout habitat. We have also used pertinent literature and other relevant information to evaluate habitat supporting bull trout.

Our evaluation of the individual elements and the concepts upon which the early action programs are based indicates that they are appropriately founded. The Model programs provide habitat protection measures that address stream flow, temperature, and other water quality attributes, as well as physical habitat characteristics. Pertinent literature reviewed for this analysis indicates that the framework used to develop the Model is based on best available science. However, it is valuable to recognize that the currently accepted technical concepts are incomplete and imperfect. These concepts should be revised, improved, and expanded over time as monitoring and independent investigations provide new information that would be incorporated through the adaptive management process. The Tri-County Model would contribute to these concept modifications through the monitoring and adaptive management actions that would occur under the Model.

Chapter 5, the sub-basin analysis provides an evaluation of the impact of the programs on properly functioning conditions (PFC) within sub-basins having a variety of development conditions. There are six sub-basins selected for this review, which represent various development intensities, from highly urban to generally rural. They include. Soos Creek, Newaukum Creek, Middle Green River, Longfellow Creek, Hamm Creek, and the Lower Duwamish River. These sub-basins were also selected based on the amount and quality of available data that describes their existing conditions. All six sub-basins are within WRIA 9, the Green River Watershed, because more complete and appropriate data were available for these sub-basins than in other WRIAs within the Tri-County area. In Chapter 5 the analysis focuses on the Soos Creek sub-basin, with summaries provided for the other sub-basins. Detailed analyses of the other sub-basins are presented in Appendix C.

Soos Creek is a largely rural sub-basin that is rapidly developing and is expected to see increasing residential and minor commercial development within the UGA and rural residential development outside the UGA. Residential use dominates the Soos Creek sub-basin, accounting for 40% of existing use and 80% of the designated use. Existing forest, primarily early to mid-successional deciduous and mix-forest types accounts for approximately 26% of the sub-basin; scrub/shrub land covers another 10%.

The Newaukum Creek sub-basin is a rural area that has a large agricultural component (47%), a relatively small residential component (22%), and approximately 28% forested area. The Soos Creek sub-basin retains substantial rural area; however, residential and commercial development is currently widespread throughout the basin. The Middle Reach Green River is a mainstem reach with substantial salmon spawning and rearing habitat. Like other middle reaches of mainstem rivers in the Tri-County area, the Middle Green River has substantial residential and commercial development that continues to expand. The Longfellow and Hamm Creek sub-basins are areas of intense residential and commercial development. Both drain to the Lower Duwamish River, an estuarine sub-basin that has intense commercial, industrial, and residential development.

The sub-basin analysis describes how the cumulative actions of the Tri-County Model programs would be expected to maintain existing conditions in the Newakum Creek sub-basin over the short term, and potentially restore conditions toward PFC in the long term. The overall effect of both the urban and rural management zone (MZ) standards of the Land Management Program would be protection of existing inner management zone (IMZ) vegetation, allowing this previously disturbed vegetation to mature over time. In the Soos Creek sub-basin, the cumulative effect of the Model programs are generally expected to maintain existing habitat conditions in the short term, and potentially improve conditions over the long term.

- The Stormwater Management Program would appreciably, but not completely, maintain groundwater inputs through infiltration and dispersion.
- Local jurisdictions do not regulate water rights that influence base flow conditions in Tri-County streams.
- Funding of habitat restoration has the potential to restore previously lost habitat functions. Physical barrier conditions are likely to be restored to PFC in both the short and long term.

The evaluation in Chapter 5 compares baseline conditions in the sub-basins to PFC, as defined in the NMFS and USFWS Matrices of Pathways and Indicators (MPI) for chinook salmon and bull trout habitat. While the existing MPI criteria were defined for relatively high gradient forested streams in headwater areas, they were used for this evaluation because, currently, there is no widely accepted definition of PFC for estuaries, mainstem rivers, and lowland Puget Sound streams. Existing MPIs, therefore, represent the best available guidance that NMFS and the USFWS rely on for effects determinations.

For this analysis, combinations of Model programs and program elements are identified that would affect PFC habitat indicators, assuming that all Model programs would be implemented within each sub-basin. The likely effects of the Land Management and Stormwater Management early action programs are assessed in Chapter 5. However, the Regional Road Maintenance Program Guidelines are assessed in an independent biological review (Tri-County 2001c). Discussion of the Regional Road Maintenance Program is incorporated into the sub-basin analysis to evaluate the effects of implementing all Model programs. The potential role of the long-term action programs (Habitat Acquisition and Restoration Funding, WRIA Based Planning, and Monitoring and Adaptive Management Programs) for achieving habitat improvements are also considered for each sub-basin.

The results of the sub-basin analysis indicate that the Model would generally maintain existing habitat conditions in urban and rural sub-basins in the short term. While existing conditions are commonly not properly functioning or at risk in the sub-basins analyzed, in vegetated riparian areas, habitat functions would likely improve as existing vegetation matures over time. Habitat restoration projects would gradually improve habitat conditions toward PFC over time, depending on the allocation of funds to each sub-basin.

The overall effect of both the urban and rural management zone (MZ) standards of the Land Management Program would be protection of existing inner management zone (IMZ) vegetation, allowing this previously disturbed vegetation to mature over time. Over the long term invasive exotic vegetation in these areas is likely to be replaced by native vegetation. In the Soos Creek sub-basin, the cumulative effect of the Model programs are generally expected to maintain existing habitat conditions in the short term, and potentially improve conditions over the long term. The Stormwater Management Program would appreciably, but not completely, maintain groundwater inputs through infiltration and dispersion. Funding of habitat restoration has the potential to restore previously lost functions. Physical barrier conditions are likely to be restored to PFC in both the short and long term. In the other sub-basins the Model early action programs would generally maintain existing conditions, while the long-term programs would tend to improve habitat conditions toward PFC.

In Chapter 6 the analysis independently evaluates each of the individual programs of the Model because some local jurisdictions may chose to adopt only one or several of the early action programs, rather than the entire Model. This review assesses the effect of each program on the habitat within the area regulated by the three counties. Individually, the Model programs have limited capacity to maintain or restore aquatic habitat providing functions for salmon and bull trout. However, each program and its individual elements does have the capacity to maintain and provide the opportunity to restore important aspects of the aquatic habitat, or to limit the effects of development.

Each program is tested for its consistency with the municipal, residential, commercial, and industrial (MRCI) development limit (provided in Appendix E) of NMFS' 4 (d) Rule for chinook salmon. The analysis used the Matrix of Pathways and Indicators (MPI) to assess compliance with ESA for chinook salmon. Bull trout habitat requirements have been identified by the USFWS (1998) in their Interim Guidance document and by other publications reviewed in Section 4.2.1. Habitat supporting bull trout spawning and early rearing tends to be in the headwater reaches of streams where the counties have scattered and minor regulatory influence. Anadromous forms of bull trout migrate and forage through mainstem reaches of streams and forage along Puget Sound shorelines, where they generally have the same basic habitat needs as salmon, with the exception of water temperature and prey sources.

The analysis in Chapter 6 relies on the results of the assessment of technical concepts presented in Chapter 4 and the sub-basin analysis in Chapter 5. Individually applied, the Stormwater Management and Land Management Programs (together with the three long-term programs) would not be expected to maintain all PFC indicators. Each program addresses some MRCI considerations substantially, some partially, and some not at all. Therefore, implementing either the Stormwater Management or Land Management Programs individually would not be expected to completely maintain or improve conditions toward PFC, and by definition, would not be consistent with the MRCI Limit.

While Model programs, individually are likely to maintain appropriate characteristics and functions of the ecosystem over the short term analysis of individual elements of the various Model programs indicates that individual application of these programs does not have the capacity to protect existing habitat conditions. Although each program has the potential to protect important aspects of the habitat required by salmon and bull trout, each program only addresses a portion of the effects that development has on required habitat within the ecosystem.

In **Chapter 7,** the **synergistic or combined effects** of implementing multiple Model programs are analyzed. The synergy among programs is identified that would contribute to the maintenance of existing conditions or improvement of habitat condition toward PFC and that would fulfill the NMFS 4(d) Rule MRCI Limit considerations. This analysis also identifies how the early action programs work jointly to maintain and protect the potential to restore PFC. The analysis evaluates the synergistic effects of the combined Model programs over the long term. The evaluation of synergistic effects on habitat conditions

applies to trends in PFC indicators and generally addresses both chinook salmon and bull trout habitat within the areas potentially regulated by the Model.

The combined effects of Model programs would improve habitat over the long term as measured by most PFC indicators. Early action programs alone would not be sufficient to maintain existing conditions or improve most habitat toward PFC. While implementation of the long-term programs is assumed, jurisdictions would need to identify, fund, and implement specific regulatory, programmatic, and capital actions through the long-term programs to prevent degradation of some PFC indicators.

Therefore, synergy among the Model programs would occur and would be necessary to protect and maintain existing conditions in the short term and improve habitat conditions in the long term, on a sub-basin and watershed scale. All of the early-action and long-term programs would be necessary to ensure that the MRCI considerations and PFC indicators are addressed.

Chapter 8 summarizes the findings of this biological review, together with its limitations. It also provides recommendations by which jurisdictions could modify and improve Model programs.

CONCLUSIONS

The Model does contribute to the persistence of existing habitat functions, and the improvement of additional habitat functions where they have been previously degraded. This improvement is likely to provide substantial habitat restoration in the long-term. However, we do not have the information available to quantitatively assess the impact of the Model on salmonid populations.

The Model is likely to conserve habitat and habitat functions supporting listed salmonid species consistent with the Endangered Species Act (ESA) and the National Marine Fisheries Service (NMFS) 4(d) Rule for threatened salmonids. The early-action programs will primarily maintain existing habitat conditions. The early-action to gather with the long-term programs will result in improvement of habitat conditions in the long term.

The Model's three early action programs would primarily maintain existing habitat conditions or minimize the effects that development potentially has on salmon and bull trout habitat. These programs would do little to improve previously degraded habitat, but would tend to maintain the opportunity to improve previously degraded habitat. Improving previously degraded habitat conditions would be accomplished primarily by the Model's long-term programs. Most of the habitat improvement is expected to be accomplished through the Habitat Funding and Acquisition Program that will be guided in part by the Monitoring and Adaptive Management Program and the Watershed Based Salmonid Conservation Planning Program (WRIA based planning).

Implementation details appropriate for numerous program elements are not included in the Model. Coordination of the jurisdictions with NMFS and the USFWS (Services) can develop standardized checklist and template to complete individual adaptations of the Model. These would include features needed to provide implementation certainty, such as planning and implementation commitments, adaptation of regulations to local conditions, funding sources, schedules, standards for quantifiable goals, and non-compliance response.

The funding that is necessary to accomplish habitat improvement and restoration would be provided by the Habitat Acquisition and Restoration Funding Program and federal funding sources. Although there is uncertainty as to the appropriate funding levels and mechanisms, the funding program would provide an accrual of habitat benefits over time.

The Model and the authority of the Counties, including local jurisdictions, is not adequate to directly address all provisions of ESA and the NMFS 4(d) Rule for threatened salmonids.

FINDINGS

- The Model's early action programs would primarily maintain existing habitat conditions or minimize the effects that development has on salmon and bull trout habitat. These programs would do little to restore previously degraded habitat, but would tend to maintain the opportunity to restore previously degraded habitat.
- The long-term action programs would provide the potential to restore previously degraded habitat, and to acquire and protect existing valuable habitat. Over time, substantial funding necessary to accomplish habitat restoration could be provided by the Habitat Acquisition and Restoration Funding Program. This program has both substantial potential and uncertainty to improve habitat conditions over the long term.
- The Model follows the basic principal of protecting or restoring natural habitat conditions, as they are currently understood, with the assumption that these natural conditions provide the most appropriate habitat for salmon and bull trout. The ecological and programmatic principles and objectives for each program are generally consistent with the habitat objectives and critical and desirable elements of guidance provided by NMFS and the USFWS. Evidence available for this review indicates that the framework used to develop the Model is based on best available science. Actual provisions within the Model may have been based in part on social and political considerations
- The sub-basin analysis indicates that the Model's affects PFC primarily for chinook salmon, but also for appropriate bull trout life stages. The Model would generally be to maintain existing conditions in the short term and potentially restore conditions in the long term.
- The Model does substantially address 6 of the 12 MRCI Limit considerations, partially addresses 5 considerations, and does not address 1 consideration (Water Supply).
- Based on evaluation of MRCI considerations and PFC discussed above, all of the early-action and long-term programs would be necessary to ensure that the MRCI considerations and PFC indicators are addressed to the greatest extent practicable by jurisdictions (although a single program may in some instances substantially address a single indicator or consideration).

RECOMMENDATIONS

- More clearly state the ecological principles as goals, and clearly state the linkages between each program's ecological goals and its programmatic elements.
- Where the Stormwater Management, Land Management, or Regional Road Maintenance Programs are implemented independently, incorporate the WRIA Based Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs.
- Recognize in the Model that habitat conditions, other than the historic natural conditions, may be satisfactory for protection and restoration of salmon and bull trout in some areas where the Model may be applied.
- Incorporate reasonable and appropriate management objectives and actions that focus on Puget Sound shoreline habitat.

- Provide specific regional protocols, or identify the process by which regional protocols would be established, so that consistent and useful monitoring programs would occur across jurisdictional boundaries.
- Coordinate efforts of the Tri-County group and the Services to develop a standardized checklist and template for jurisdictions to complete their individual adaptations of the Model.
- Effectively implement all programs to maintain and potentially restore appropriate habitat conditions at a watershed scale.
- Include an agriculture management program that would provide a more consistent and efficient means for jurisdictions to apply for 4(d) coverage.
- Improve the Model by including a process to engage all necessary participants, link all ongoing related water elements, and facilitate water management decisions involving water supply.
- Define how the Model programs would incorporate new internal and external scientific information through the Monitoring and Adaptive Management Program.
- Include a process to ensure that adaptive management actually occurs on a routine schedule following appropriate guidelines.
- Specify the appropriate commitments to be made by adopting jurisdictions in the Watershed Based Salmonid Conservation Planning, the Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs.

Although most aspects of the Model have and would continue to be debated, it is clear that application of the Model would certainly reduce the effects of development on habitat conditions for salmon and bull trout compared to past practices. Most likely, the greatest improvement to the Model and long-term benefits to habitat restoration would come from increased funding of habitat restoration that is expended in a manner that addresses issues of watershed scale functions. Sustained federal funding is demonstrated to be particularly important to expedite habitat improvements and gains in species recovery.

LIMITATIONS

- This Biological Review evaluates the general expected effects of the Model in the Tri-County region. The Biological Review does not provide an in-depth analysis of implementation of the Model in specific watersheds and jurisdictions; rather, it forms a basis upon which local jurisdictions would build their own analysis. The specific effects of the Model on local PFC would require jurisdictions to analyze and report local baseline habitat conditions, physical and geological constraints, and detail on the jurisdiction's proposed adaptation of the Model (particularly the long-term programs).
- The review relies on the NMFS and USFWS Matrices of Pathways and Indicators (MPIs) as the best available published guidance for evaluation of program effects. These MPIs are a coarse set of criteria, designed to be adapted as necessary to specific regions and species. These MPIs were developed for higher-elevation headwater streams. PFC for Puget Sound lowland streams have not been defined.
- The effectiveness of the Model programs at addressing habitat and population concerns at larger scales (watershed and sub-basin) is yet relatively untested. Conclusions of the sub-basin analysis are generally representative of the widely varying land-use characteristics, but do not represent the full range of conditions within the three counties.

- The analysis included only limited sources independent of those used in formulation of the Model. Analysis of many concepts and programs relied on currently accepted biological and engineering principles, with the explicit expectation that the program elements would be specifically evaluated and improved over time under the long-term action programs.

1. INTRODUCTION

Chapter 1 of the biological review document provides an overview of the Tri-County Model 4(d) Rule Response Proposal (Model) and identifies goals and strategies of the Tri-County Salmon Conservation Coalition in recovering chinook salmon and bull trout in the Tri-County region.[1] This chapter includes the following sections:

1.1 Overview of the Tri-County Salmon Conservation Coalition and Model 4(d) Rule Response
- 1.1.1 Tri- County Salmon Conservation Coalition Goals and Strategies
- 1.1.2 Approach of Tri-County Model 4(d) Rule Response

1.2 Background of the ESA Listings
- 1.2.1 ESA Listing of Puget Sound Salmon and Bull Trout
- 1.2.2 Section 4(d) of the ESA
- 1.2.3 Recovery Planning and Tribal Treaty Rights
- 1.2.4 Model Relationship to Recovery Planning

1.3 Model Implementation Options

1.4 Purpose and Application of the Biological Review

1.5 Organization of the Biological Review

1.1 OVERVIEW OF THE TRI-COUNTY SALMON CONSERVATION COALITION AND MODEL 4(d) RULE RESPONSE

In response to the federal listing of the Puget Sound evolutionarily significant unit (ESU) of chinook salmon (*Oncorhynchus tshawytscha*) and the Coastal Puget Sound distinct population segment (DPS) of bull trout (*Salvelinus confluentus*) as threatened species under the Endangered Species Act (ESA), cities and counties in the Snohomish, King, and Pierce county area joined together with the business community, ports, the environmental community, Tribes, and the state of Washington for the common purpose of recovering chinook salmon and bull trout[2]. This Tri-County effort, the Tri-County Salmon Conservation Coalition, resulted in the Tri-County Model 4(d) Rule Response Proposal (May 18, 2001). Figure 1-1 outlines the Tri-County area and shows the watershed boundaries within the Puget Sound ESU.[3]

1.1.1 Tri-County Salmon Conservation Coalition Goals and Strategies

The overall goal of the Tri-County Salmon Conservation Coalition effort is to "recover Puget Sound chinook salmon and other listed salmonids without undermining the region's economy." The Convening Vision Statement and Principles for Tri-County ESA Response provided the fundamental vision and principles around which the Model was formed as follows:

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[1] This chapter was prepared by Tri-County staff and represents only a description of and/or excerpts from the Model. The analysis of the Model in subsequent chapters (Chapters 3-9) was prepared separately by Parametrix, Inc.

[2] Chinook salmon and bull trout are both members of the family salmonidae; the term salmonid is used throughout this document to refer to both chinook salmon and bull trout.

[3] The USFWS is currently determining critical habitat for five distinct population segments of bull trout, and is scheduled to complete a proposed designation for the Coastal-Puget Sound population segment in September 2003. A map of the distribution of this population segment is not yet available.

Figure1-1. Tri-County Area Within Puget Sound Region

Watersheds within Puget Sound Chinook ESU

Puget Sound Chinook ESU

Tri-County Focus Area

County Boundary

Watershed Boundary

N

Snohomish County

Our Vision - Act cooperatively to develop a responsible, comprehensive, science based recovery plan, providing a credible response to federal ESA listings of Puget Sound salmonids.[4].

Our Goal - Restore and maintain healthy salmonid populations and protect the estuaries, rivers, and streams[5] on which they rely, based on the best available science.

Salmonids are an integral part of the region's history, culture, environment, and economy. Their need for clean, abundant, cool water must not be overlooked as population and economic growth continue. Tri-County Coalition defined the challenge and necessary response actions as follows:

Our Challenge - In particular, the federal listing of Puget Sound salmonids under the ESA challenges this region to reverse trends that threaten or endanger the existence of our native salmonids. We must meet this challenge in harmony with our population growth and economic prosperity.

What We Must Do - We must be willing to work together to explore ways to help chinook salmon and bull trout recover and to resolve water resource conflicts. Water that flows from the Cascades to Puget Sound is affected by land uses within many political boundaries and is shared in many, sometimes conflicting, ways. Unfortunately, this can affect the quality, quantity, and habitat conditions needed for salmonids to survive. Therefore, we must:

- Reach for a better understanding of all water resource interests, especially the needs and life cycle of salmonids;
- Avoid economic disruption to the greatest extent practical, assure adequate water supplies, and better manage the public's precious water resources; and,
- Develop and implement a salmonid recovery strategy in response to any listing under the ESA based on partnerships between governments, Tribes, economic interests, and the general public (Tri-County 1998).

Further, the Tri-County Convening Vision Statement and Principles provide the following guiding principles that guided the Model:

- The strategy must be comprehensive, long-range, and action oriented. This means it must be based on best available science; must set priorities; and must be adaptive in response to ongoing data collection, monitoring, and review.
- The strategy must recognize local watershed initiatives and develop linkages among such efforts. This means to: implement solutions at the local level; seek ways to use limited resources effectively in meeting water resource needs; avoid actions that require expenditure of resources on programs and projects that do not address priority needs; and build on existing, successful programs to address priorities without creating new layers of government and bureaucracy.
- The strategy must avoid inflexible region-wide mandates and standards that might impede unique local programs; must include regulatory and non-regulatory approaches; and must maintain a healthy economy.

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[4] The Model, in some cases, used the term "salmon" to refer to both chinook salmon and bull trout. In this biological review, the term "salmonid" is used to refer to both species. Text quoted from the Model has been revised accordingly.

[5] This goal also applies to nearshore marine habitat, although not stated specifically. Nearshore marine habitat was added to and addressed in the Model after this initial Tri-County goal was written.

- The strategy must take full advantage of existing state and local authorities, tools, and programs in support of immediate action to restore salmonids. It should build on existing laws, regulations, and programs that contribute to salmonid protection and.
- The successful strategy should reduce the risk of unnecessary federal intervention (Tri-County 1998).

1.1.2 Approach of Tri-County Model 4(d) Rule Response

The Tri-County effort recognizes that recovery of federal ESA-listed species requires a comprehensive, ecosystem approach that uses best available science. It is expected that species recovery will focus heavily, although not solely, on habitat protection. The recommended measures presented in the Model are intended to contribute to the conservation of ESA-listed species through a multi-species approach to protect and restore aquatic habitat characteristics that support and contribute to the productivity, diversity, and abundance of salmonids. This restoration strategy is designed to be flexible and to incorporate an effective adaptive management approach. Ecological principles guiding the Model are detailed in Chapter 2.

The Model builds upon existing local government environmental regulations. Under the Washington State Growth Management Act (GMA), all cities and counties in the Tri-County region are required to adopt development regulations that designate and protect critical areas (RCW Chapter 36.70A). Critical areas include wetlands and fish and wildlife habitat conservation areas (RCW 36.70A.030(5)), and cities and counties are required to designate and protect these areas (RCW 36.70A.060 and 36.70A.170). Development regulations must be based on best available science, with special consideration given to measures necessary to preserve or enhance anadromous fisheries (RCW 36.70A.272). Washington's Shoreline Management Act (SMA) establishes a comprehensive program for the protection of Washington's marine shorelines and larger rivers and lakes (RCW Chapter 90.58). Cities and counties throughout the state are required to adopt shoreline master programs that meet these goals. These shoreline master programs must be approved by the Washington State Department of Ecology (Ecology) before they are implemented.

The Model does not presume to duplicate these or any other existing local government programs. It is intended to supplement such programs and provide guidance on how to achieve the goals of the Tri-County Salmon Conservation effort through changes to local programs implementing the authorities outlined above.

The Model can be adopted in whole or in part by local jurisdictions (see Section 1.3). Any local government that proposes a program to the National Marine Fisheries Service (NMFS) or the United States Fish and Wildlife Service (USFWS) that it believes meets the requirements of the NMFS municipal, residential, commercial, and industrial (MRCI) take limit, or a special rule that might later be issued by USFWS providing a reduction or elimination in the prohibition on take for bull trout, will need to include those measures that it has adopted to implement the Model, as well as other aspects of its regulatory program to demonstrate that it meets the requirements established by both NMFS and the USFWS (Services).

This biological review identifies the biological effects of the Model over a period of approximately 100 years and evaluates the Model as if it were applied consistently throughout the Tri-County region.

1.2 BACKGROUND OF THE ESA LISTINGS

For well over a century, human activities have contributed to the loss of naturally producing native stocks of salmonids, a Pacific Northwest icon. Some salmonid stocks have been rendered extinct, their unique contributions to genetic diversity and ecosystem health thus lost. Many other stocks have been so reduced that, to preserve opportunity for future recovery, little fishing has been permitted in recent years. As a result of this continuing decline, several imperiled salmonid stocks throughout the West Coast have been granted the protection of the ESA by federal agencies.

The ESA was enacted by Congress in 1973 to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved, and to provide a program for the conservation of such species (16 USC Section 1531(b)). A species is considered endangered when it is "in danger of extinction throughout all or a significant portion of its range" and threatened when it is "likely to become endangered within the foreseeable future throughout all or a significant portion of its range" (16 USC Section 1532(6), (19)). Chinook salmon, also known as king salmon, attain the largest body size of any salmon species. These fish once abounded in Puget Sound and in its larger stream systems, but have declined dramatically during the last 15 to 20 years. In May 1999, the federal government listed the Puget Sound chinook salmon ESU as threatened under the ESA.

Bull trout, never as abundant as other salmonids, have declined precipitously as well. In December 1999, bull trout were listed as threatened in the coterminous United States, including the Puget Sound region. Coho salmon, Lake Sammamish kokanee, steelhead, and sea-run cutthroat have also come under scrutiny for listing under the ESA. NMFS has concluded, however, that listing coho and steelhead species is not yet warranted, but their status will be tracked and future listings are possible.[6] The USFWS reached a similar conclusion regarding sea-run cutthroat, but has yet to reach a decision on Lake Sammamish kokanee.[7]

1.2.1 ESA Listing of Puget Sound Salmon and Bull Trout

Chinook salmon and bull trout were listed as threatened under the ESA based on several factors for decline (64 FR 14307 at 14316, March 24, 1999; 64 FR 58910, November 1, 1999). The Services have determined that the following factors are contributing to the decline of chinook salmon and bull trout:

- Habitat loss (due to fragmentation, natural resource use, draining and filling of freshwater and estuarine wetlands, dewatering, increase in impervious surface, water quality degradation, and sedimentation),
- Hydroelectric projects and flood control (including habitat blockage, shifts in flow regime, and sedimentation),
- Harvest, and
- Hatchery operation impacts (including impacts to genetic fitness and intrusion of non-native species).

[6] NMFS is the federal agency charged with overseeing all listings involving marine mammals and anadromous (ocean-going) fish species. NMFS is a division of the National Oceanic and Atmospheric Administration (NOAA) within the U.S. Department of Commerce.

[7] The USFWS handles all listings involving wildlife and resident fish and plant species. USFWS is a division within the U.S. Department of the Interior.

In their listing determinations, the agencies stated that these factors for decline result in increased stream temperatures, streambed instability, estuarine loss, loss of large woody debris, loss of pool habitat, curtailment of tributary and mainstream habitat, losses of slough and side-channel habitat, and other reductions in habitat quantity and quality.

Hydroelectric, harvest, and hatchery factors for decline are largely beyond the authority of local governments and are instead controlled by the state of Washington, federal government, Tribes, or various combinations of those entities. Local governmental agencies in Washington State can affect the habitat factors for decline, at least to some degree, because they can regulate their own proprietary activities such as road construction and maintenance, public facility construction, stormwater and wastewater facilities, and park management, as well as land use activities, over which they have substantial but not total statutory or common law authority[8].

1.2.2 Section 4(d) of the ESA

NMFS and USFWS follow separate procedures to apply Section 4(d) of the ESA, which grants the Secretaries of Interior and Commerce (and by delegation USFWS and NMFS) broad administrative discretion to promulgate regulations that are necessary and advisable to provide for the conservation of threatened species. Section 4(d) also confers upon the Secretaries, and thus upon the Services, discretion to apply to a threatened species any or all of the prohibitions against take that automatically apply to endangered species via ESA Section 9.

USFWS has a standing regulation that effectively applies ESA's Section 9 prohibition against take to threatened species at the time of listing (codified at 50 CFR 17.31(a)). In other words, take prohibitions automatically apply when USFWS lists a species as threatened, such as the bull trout. NMFS does not have a standing prohibition on take of threatened species. Instead, NMFS uses its authority under Section 4(d) to adopt protective regulations on a species-by-species basis. The NMFS protective rules usually incorporate the ESA Section 9 prohibition on take. However, both of the Services sometimes promulgate more detailed 4(d) rules for threatened species.

NMFS 4(d) Rule for Threatened Salmon and Steelhead

When NMFS issues a 4(d) Rule, the rule may apply the Section 9 prohibition of take, but limit the application of that prohibition to certain activities. The decision to limit the take prohibition is based on a determination that such activities are already adequately regulated, or are unlikely to cause prohibited take if executed in a manner approved by NMFS. NMFS adopted a detailed 4(d) Rule in July 2000, codified at 50 CFR 223.203, to prohibit take of 14 groups of salmon and steelhead (including Puget Sound chinook) listed as threatened under the ESA. The NMFS 4(d) Rule for salmon and steelhead took effect within the Threatened Steelhead ESUs on September 8, 2000, and the rule became effective within the Threatened Salmon ESUs on January 8, 2001. There are 13 take limits in the NMFS 4(d) Rule. Through these take limits, NMFS recognizes that the following activities may be sufficiently regulated to provide for the needs of listed species:

1. ESA permit under Section 10 (Habitat Conservation Plans),
2. Ongoing scientific research conducted by or coordinated with state fishery agencies,
3. Rescue and salvage actions,
4. Fishery management,

[8] The federal government, state of Washington, and many Tribes have authority over some habitat factors for decline including forestry, withdrawal of surface and groundwater, discharge to surface waters, construction within water bodies, pesticide use, and marine environment activities.

5. Artificial propagation programs,
6. State and tribal resource management plans,
7. Scientific research permitted or conducted by states,
8. Habitat restoration activities pursuant to watershed plans that meet criteria approved by NMFS,
9. Water diversion screening consistent with NMFS criteria,
10. Certain routine road maintenance programs,
11. Portland Parks Integrated Pest Management,
12. MRCI development and redevelopment, and
13. Washington forest practices consistent with regulations adopted under the Fish and Forest Report.

Limit 12 of the NMFS 4(d) Rule states that the rule's prohibition on take does not apply to MRCI development and redevelopment activities that occur pursuant to an ordinance or plan that NMFS has determined to be adequately protective of listed species. Limit 12 outlines 12 evaluation considerations that NMFS will apply when reviewing MRCI development plans or ordinances to assess whether they adequately conserve listed salmonids by maintaining and restoring properly functioning (habitat) conditions (PFC)[9]. NMFS will find the MRCI development plan or ordinance to be consistent with the conservation of listed salmonid habitat when it contributes to the attainment and maintenance of PFC. Actions that affect salmonid habitat must not:

- Impair properly functioning habitat,
- Appreciably reduce the functioning of already impaired habitat, or
- Retard the long-term progress of impaired habitat toward PFC (50 CFR Section 223.203(b)(12)(iii).

The NMFS 4(d) Rule is included in Appendix E of this biological review.

USFWS Special Rule for Threatened Bull Trout

When USFWS promulgates a detailed 4(d) rule for threatened species, it is called a special 4(d) rule. If deemed appropriate by USFWS, a special 4(d) rule may be adopted to eliminate or reduce the prohibition on take (under Section 9 of the ESA) for activities that may affect a particular threatened species for which the USFWS is responsible. The USFWS published a special rule for bull trout on November 1, 1999, in the Federal Register (64 FR 58909-58933 November 1, 1999). That rule applies the ESA Section 9 take prohibition to bull trout, but exempts certain fishing programs, educational programs, and scientific activities from the prohibition. On the same date, the USFWS published a "Notice of Intent to Prepare a Proposed Special Rule Pursuant to Section 4(d) of the Endangered Species Act for the Bull Trout" (64 FR 58934-58936 November 1, 1999). The notice stated that the USFWS is considering amending the existing special rule to exempt two additional categories of other activities that may affect bull trout: habitat restoration and other land and water management activities governed by enforceable

[9] Limit 12 defines PFC as "the sustained presence of a watershed's habitat-forming processes that are necessary for the long-term survival of salmonids through the full range of environmental variation" (50 CFR Section 223.203(b)(12)(iii)). When NMFS adopted the 4(d) rule for West Coast salmon and steelhead, NMFS stated that "the concept of PFC recognizes and accomodates the fact that essential ecological functions may be different in spawning and rearing habitats often found in forested enviroments, for instance, than in migratory corridors, often found in urban settings" (Federal Register, Vol. 65, No. 132, p. 42458, July 10, 2000). Thus, the habitat functions and values that constitute PFC may differ both within and between watersheds.

regulations that provide substantial protection for bull trout. Until such an amendment is published, however, the prohibition on take in the existing special rule will continue to apply.

1.2.3 Recovery Planning and Tribal Treaty Rights

Under Section 4(f) of the ESA, NMFS and USFWS have the responsibility and authority to undertake recovery planning for chinook and bull trout, respectively. Implementation of this section of the ESA would result in a recovery plan for the listed species that would describe the status of the species and its factors for decline, as well as measures that should be undertaken to recover and de-list the species.

Customarily, the Services complete a recovery plan by forming an interdisciplinary group of federal and academic scientists to undertake necessary scientific analysis as background for subsequent work by program and policy staff to develop and finalize the recovery plan. The Services have completed dozens of recovery plans in this manner. This approach has produced mixed results at best, however, with difficulty completing recovery plans in some instances, inconsistent recovery plan implementation in others, and a small number of species (such as the bald eagle) actually reaching a recovered status.

The Services therefore have chosen an alternative approach to implementing Section 4(f) in the Puget Sound region. They participate in the Puget Sound Shared Salmon Strategy (Shared Strategy) in the hopes that this uniquely collaborative mechanism will develop and implement recovery plans for chinook salmon and bull trout. The Shared Strategy was initiated in the year 2000 by a group of eight salmon conservation leaders, including private, local, Tribal, state, and federal leaders from throughout Puget Sound. It is designed to be an open and accessible recovery planning process to coordinate watershed and regional planning efforts to create a program that can return salmon stocks throughout Puget Sound to sustainable and harvestable levels. [10]

In performing recovery planning duties, the Services are obliged to ensure that their actions are in accordance with their trust responsibilities for Tribal rights guaranteed in various treaties signed with the United States government[11]. Specifically, two treaties were negotiated and ratified in the Tri-County area: the Treaty of Point Elliott and the Treaty of Medicine Creek. In these treaties, the Tribes gave up the majority of the land that today comprises Snohomish, King, and Pierce Counties, but retained, among other things, their rights to "… fish at all usual and accustomed grounds and stations …." Subsequent federal court decisions have interpreted this language in terms of specific allocation of harvestable fish between treaty tribes and other interests and in terms of specific limitations on the ability of non-Indian management agencies to apply conservation regulations to treaty tribes.

The process for setting and achieving recovery goals will acknowledge treaty rights by accommodating harvest as part of the goal. The co-managers (Washington Department of Fish and Wildlife and appropriate Tribes), as a portion of the overall development of a Recovery Plan and recovery goals within the Shared Strategy, are adopting planning targets that, if met, would achieve this standard. The Shared Strategy is developing a framework within which specific recovery efforts will take place at the watershed level and be combined at the Puget Sound scale to determine if recovery and de-listing goals have been achieved. Developing and implementing successful Recovery Plans for chinook and bull trout will be a complex endeavor because habitat, hatchery, and harvest management will have to be considered concurrently. This complexity makes the need to integrate salmon recovery efforts across

[10] See the Shared Strategy website at http://www.sharedsalmonstrategy.org. for information and a schedule of deliverables.

[11] Detailed policy direction for carrying out the federal trust responsibility relative to ESA considerations is contained in Secretarial Order # 3206: American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the ESA, United States Departments of Interior and Commerce, June 5, 1997. See http://www.tulalip.nsn.us/esatribe.html .

harvest, hatchery, and habitat management actions paramount to ensure that federal obligations are met and that actions necessary to meet them are effective and feasible.

The co-managers have provided information regarding the application of Ecosystem Diagnosis and Treatment (EDT) analysis methodologies to developing recovery goals for Puget Sound chinook populations in Appendix A (provided by Kit Rawson of the Tulalip Tribe). This analysis is provided for informational purposes, but it is not a product of Tri-County Salmon Conservation Coalition or Parametrix, Inc.

The Nisqually, Puyallup, Tulalip, Stillaguamish and Muckleshoot Tribes provided information and guidance during the development of the Model to ensure that their interests in maintaining harvestable salmonid populations were represented.

1.2.4 Model Relationship to Recovery Planning

It is important to recognize that the Model is not a recovery plan, but rather a model program to assist jurisdictions in complying with the 4(d) rule and seeking take limits (NMFS) or obtaining a reduction or elimination of the take prohibition (USFWS); however, the Model does contain two aspects important to recovery planning:

- The long-term action programs (Watershed Based Salmonid Conservation Planning [WRIA Based Planning] Program, Monitoring and Adaptive Management Program, and Habitat Acquisition and Restoration Funding Program) will directly support to recovery planning efforts in Puget Sound. These long-term action programs are essential to achieving significant gains for conservation and recovery actions that will ultimately result in de-listing.
- The early-action programs (Land Management Program, Stormwater Management Program, and Regional Road Maintenance ESA Program Guidelines) are intended to avoid or minimize further harm to habitat. These programs have a less direct correlation to recovery planning, although they do contribute to long-term recovery goals (see Figure 1-2).

The Model is intended to provide options for local jurisdictions to contribute to the conservation of listed salmonids and potentially obtain coverage under the 4(d) Rule issued by NMFS or any special rule for bull trout that the USFWS may promulgate in the future. The Model includes the following three early action programs, which were developed to avoid further harm to chinook salmon and bull trout:

- Land Management
- Regional Road Maintenance ESA Program Guidelines
- Stormwater Management Program.

In addition, the Model also includes the following long-term action programs:

- WRIA Based Planning Program
- Monitoring and Adaptive Management Program
- Habitat Acquisition and Restoration Funding Program

Figure 1-2 shows the relationship of the early and long-term programs to recovery planning.

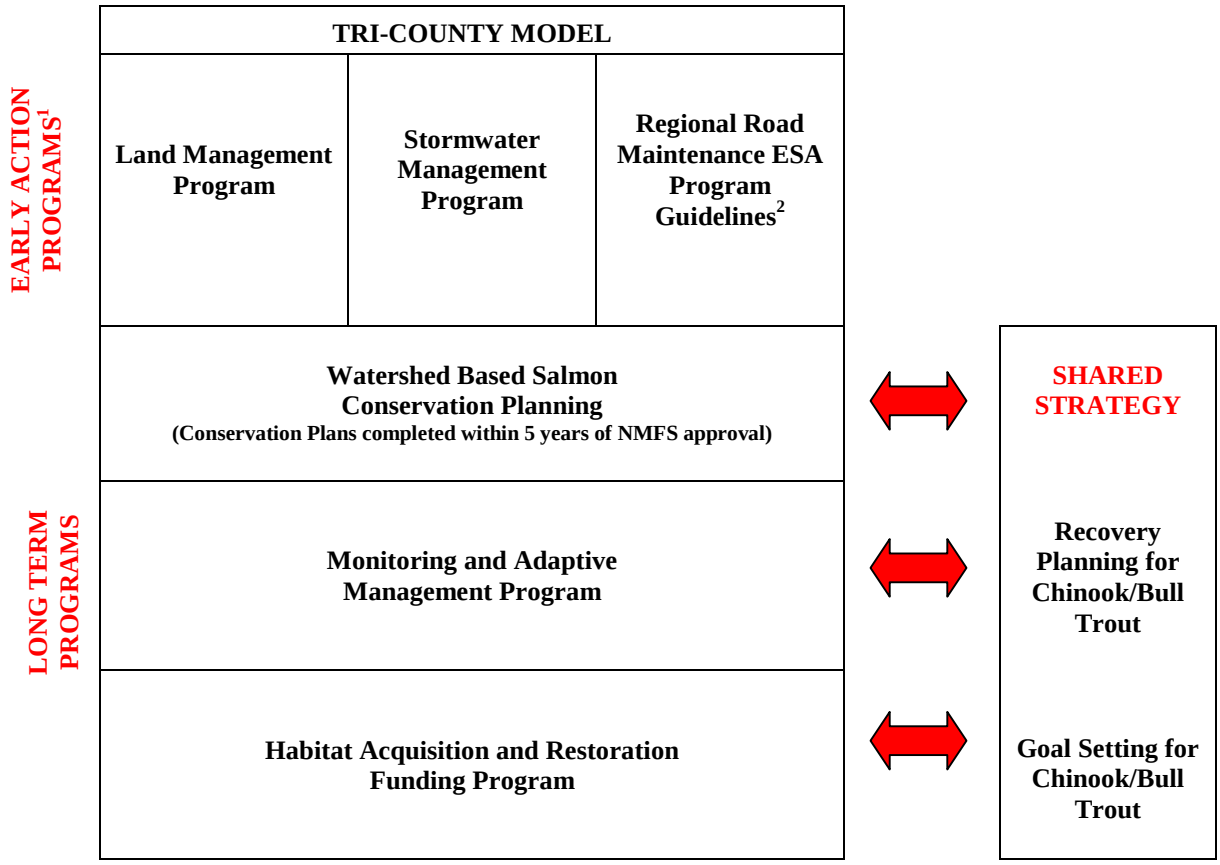

Figure 1-2
Model Early- and Long-Term Program Relationship to Recovery Planning

Notes:

1 The early action programs are implemented immediately and will be modified by long-term programs. Furthermore, there are planning, monitoring and adaptive management elements within the individual early action programs; these elements overlap to some extent with the long-term programs. For example, the stormwater planning requirement is part of an early action program, but will also have a long-term planning role that is related to WRIA based planning

2 The Regional Road Maintenance ESA Program has been submitted to NMFS under a separate 4(d) rule take limit, Limit 10. NMFS published notice of availability and request for comments on the submittal in the Federal Register at Volume 65, No. 17, p.3688 (January 25, 2002) (Regional Road Maintenance ESA Forum 2002a). As a result, the Regional Road Maintenance ESA Program Guidelines may be implemented as a stand-alone program separate from the stormwater and land use programs. This program has a Monitoring and Adaptive Management component, but does not require participation in the WRIA Based Planning or Habitat Funding Programs.

1.3 MODEL IMPLEMENTATION OPTIONS

The Model covers both short- and long-term actions to protect and restore habitat and contribute to the recovery of Puget Sound chinook salmon and bull trout. Individual members of the Tri-County coalition have not been asked to endorse the entire Model. The Model is a framework that jurisdictions throughout Washington can use to implement individualized ESA response programs at the local level. The Model also provides a blueprint for those jurisdictions seeking to submit a proposal for a take limit under 1 or more of the 13 take limits found in the NMFS 4(d) Rule. The Model may also assist jurisdictions in developing programs to qualify for a future reduction or elimination of the take prohibition on bull trout. Whether a jurisdiction's program would also qualify for a reduction or elimination of the take prohibition on bull trout will depend on whether (and if so, the extent to which) the USFWS adopts a new or amended special 4(d) rule for bull trout.

Once the biological review is complete, local jurisdictions will have the following implementation options. These options are intended to provide each jurisdiction with the flexibility to determine how the Model best fits its particular circumstances (see Executive Summary of the Model)

1. Implement the Land Management and Stormwater Management Programs as outlined in the Model and participate in the WRIA Based Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs. A jurisdiction would obtain a take limit under Limit 12 in the NMFS 4(d) Rule at such time as NMFS approves the jurisdiction's legislative or administrative actions to: 1) adopt necessary regulations and 2) commit to a schedule to implement all other programmatic elements. The Regional Road Maintenance ESA Program Guidelines could be adopted individually as a stand-alone program, without implementation of WRIA Based Planning and the Habitat Funding Programs.

2. Based on the specific circumstances or conditions in a watershed or the policy choices of a jurisdiction, a jurisdiction may propose and implement a modified Land Management Program, Stormwater Management Program, or both, plus all of the Model's long-term programs (including WRIA Based Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding) as outlined above. Jurisdictions proposing a modification would also need to demonstrate to NMFS that the modified 4(d) program provides protection equivalent to the Model program. Take limitations and/or reduction or elimination in take prohibition would apply once a jurisdiction adopts ordinances or rules and NMFS approves them, as noted in 1 above.

3. Use the Model to guide revisions to the jurisdiction's existing regulations and programs governing MRCI development and redevelopment to achieve greater salmonid conservation protection and thereby reduce risks of take liability or third party actions without applying to NMFS for a formal 4(d) Rule on take limitation. This option would allow a jurisdiction to improve its regulations and programs to reduce risk on a schedule and to an extent that it determines is achievable given its specific circumstances. While this option would not directly qualify a jurisdiction for a take limit, it would allow a jurisdiction to later apply for a take limit if that jurisdiction later chose to fully implement the Model programs or a modified version of the program, as described in 1 or 2 above.

1.4 PURPOSE AND APPLICATION OF THE BIOLOGICAL REVIEW

The Tri-County Executive Committee approved the initial scope of work for this biological review that set forth two overall purposes. This biological review was directed to determine whether the Model would:

- Contribute to the persistence of existing habitat functions and the restoration of additional habitat functions sufficient to support sustainable, harvestable salmonid populations, and
- Conserve listed salmonid species consistent with the ESA and the NMFS 4(d) Rule for threatened salmonids (Tri-County 2002).

The scientific basis and rationale for the Model are described and evaluated as part of this biological review. This analysis will evaluate whether (and if so, the extent to which) the Model meets the following criteria:

- Is consistent with the ecological framework and biological principles upon which the Model relies,
- Provides additional or synergistic benefits to listed species if all program elements are implemented across a given landscape, and

- Addresses the evaluation considerations contained in the MRCI limit in the NMFS 4(d) Rule for take protection of threatened salmonids (Tri-County 2002).

Furthermore, the biological review will determine whether the Model provides for the conservation of chinook salmon and bull trout considering identified factors of decline. The biological review will:

- Recognize the factors of decline for chinook salmon and bull trout, including the destruction or adverse modification of near-shore marine, estuarine, and freshwater habitats, and the riparian areas and watersheds that support them (16 USC Section 1533(a)(1); 64 FR 14307 at14316, March 24, 1999).
- Acknowledge that local governments have authority or responsibility only over certain actions that affect habitat (not harvest, hatcheries, or hydroelectric projects). The purpose of the Model is to provide guidance for regulations and programs that address those actions.
- Evaluate the biological effects of the programs of the Model, both individually and collectively, on habitat.
- Relate the biological effects to the factors for decline (see first bullet above) and to the considerations of 4(d) rule requirements. Determine whether the Model contributes to the persistence and/or restoration of habitat functions to support sustainable, harvestable salmonid populations.

The results of these analyses are intended to satisfy the best available science criteria for decision-making under the GMA (RCW Chapter 36.70A; WAC 365-195-900 through -925) and to further inform individual jurisdictions as they craft local responses to the chinook salmon and bull trout listings. As described above, Tri-County jurisdictions can use information presented in the biological review (in several ways (see Figure 1-3, Decision-Making Flow Chart). Once the biological review is complete, local jurisdictions will have the following choices:

- Use the Model and results of the biological review, pursue formal coverage under the ESA (a take limit under the NMFS 4(d) Rule, or a reduction/elimination of take prohibitions under a future USFWS special rule). This application relates to Model implementation options 1 and 2, Section 1.3 above.
- Apply the Model (in whole or in part) using best available science (without formal coverage under ESA). This application corresponds to Model implementation option 3 (see Section 1.3 above).

This biological review incorporates the separate biological review of the Regional Road Maintenance ESA Program Guidelines (Regional Road Maintenance ESA Forum 2001b) by reference. The Biological Review of the Regional Road Maintenance ESA Program Guidelines text is included on compact disk inside the back cover of this document.

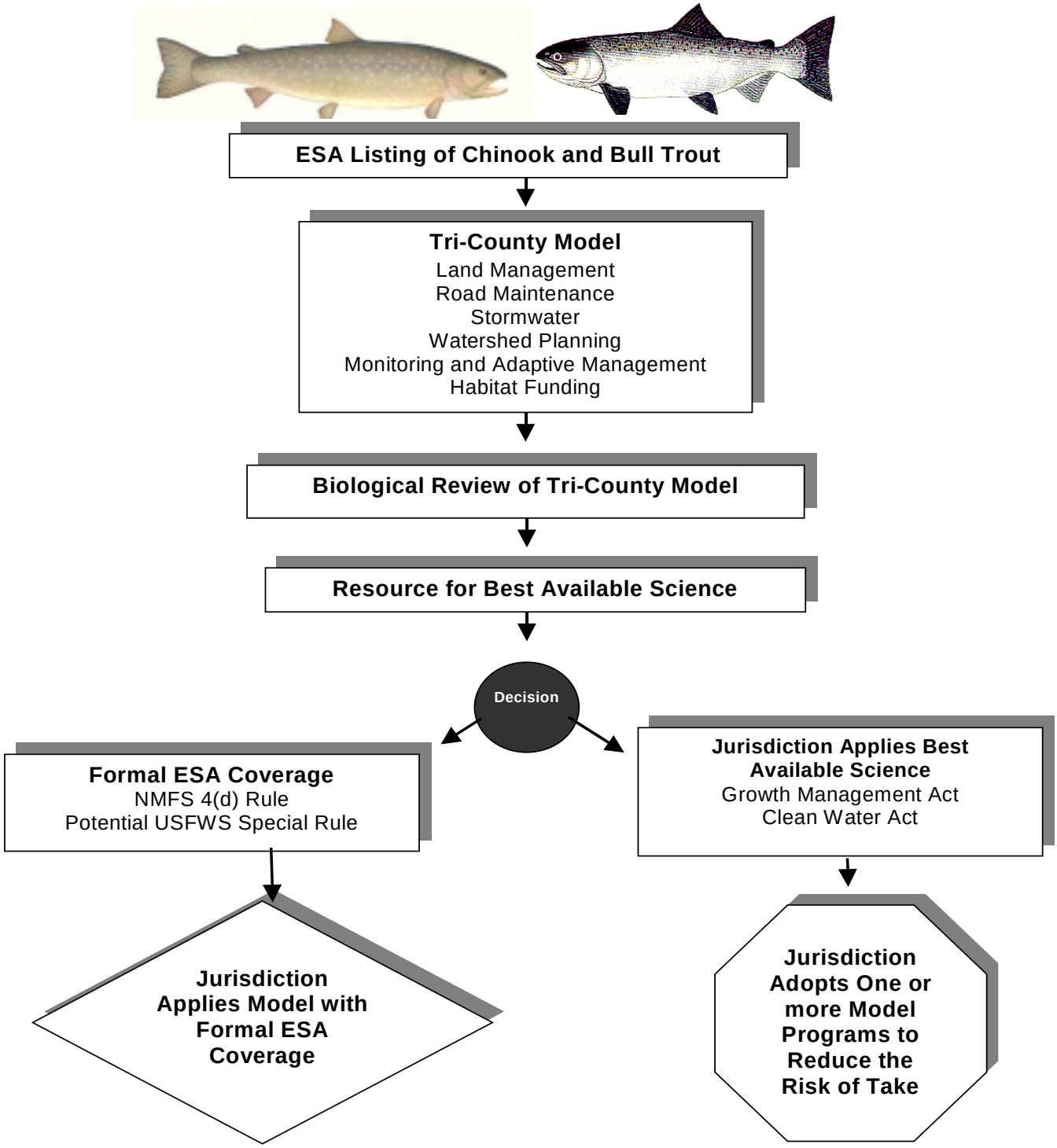

Figure 1-3
ESA Listing of Chinook Salmon and Bull Trout

1.5 ORGANIZATION OF BIOLOGICAL REVIEW

Chapter 1: Introduction

Chapter 2: Description of the Model and its Ecological Framework

Chapter 3: Overview of Assessment Methodologies

Chapter 4: Consistency of the Model with Federal Guidance and Scientific Literature

Chapter 5: Analysis of Model Effects on Selected Sub-Basins

Chapter 6: Individual Effects of the Model Programs

Chapter 7: Synergistic Effects of the Model Programs

Chapter 8: Findings and Recommendations

Chapter 9: References

2. DESCRIPTION OF THE MODEL AND ITS ECOLOGICAL FRAMEWORK

Chapter 2 describes each program in the Tri-County Model 4(d) Rule Response Proposal (Model; Land Management, Stormwater Management, Regional Road Maintenance ESA Program Guidelines, Watershed Based Salmonid Conservation Planning [WRIA Based Planning], Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs) and explains the ecological framework used to develop the programs.[12] Chapter 2 includes the following sections:

2.1 Model Programs
- 2.1.1. Land Management Program
- 2.1.2. Stormwater Management Program
- 2.1.3. Regional Road Maintenance ESA Program Guidelines
- 2.1.4. WRIA Based Planning Program
- 2.1.5. Monitoring and Adaptive Management Program
- 2.1.6. Habitat Acquisition and Restoration Funding Program

2.2 Ecological Framework of the Model
- 2.2.1. Land Management Program
- 2.2.2. Stormwater Management Program
- 2.2.3. Regional Road Maintenance ESA Program
- 2.2.4. WRIA Based Planning Program
- 2.2.5. Monitoring and Adaptive Management Program
- 2.2.6. Habitat Acquisition and Restoration Funding Program

2.1 MODEL PROGRAMS

The Model is intended to apply to the full geographic scope of habitat for chinook salmon and bull trout throughout the Tri-County region, including estuarine, near-shore marine and freshwater habitats, and the watersheds draining to them.

The Model is composed of six programs. The program descriptions provided in this biological review are derived from the Model itself. Additional sources of information and guidelines contained within the Model are also noted herein. The six Model programs include:

1. Land Management
2. Stormwater Management Program
3. Regional Road Maintenance ESA Program Guidelines
4. WRIA Based Planning Program
5. Monitoring and Adaptive Management Program
6. Habitat Acquisition and Restoration Funding Program

[12] This chapter was prepared by Tri-County staff and represents only a description of and/or excerpts from the Model. The analysis of the Model in subsequent chapters (Chapters 3-9) was prepared separately by Parametrix, Inc.

Land Management, Stormwater Management, and Regional Road Maintenance are designated as early-action programs that would be implemented and modified by long-term actions over time. Watershed Based Salmonid Conservation Planning (WRIA Based Planning), Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs are designated as long-term action programs. These programs are intended to implement, evaluate, and improve the effectiveness of the Model at protecting and restoring salmonid habitat. The success of the Model is dependent on effective implementation of both the long-term and early-action programs. A description of each program is presented in the following sections.

2.1.1 Land Management Program

The Land Management Program includes both planning and regulatory elements:

- The planning element describes Land Management Model Planning Policies that, when adopted by counties and cities under the Growth Management Act (GMA; Chapter RCW 36.70A), will ensure that counties and cities consider chinook salmon and bull trout habitat protections when making land use decisions (see Executive Summary of the Model).
- The regulatory element describes Land Management Development Regulations that can be implemented through various regulatory tools already available to local government (such as critical areas ordinances; shoreline master programs; class IV forest practices permits; clearing, grading, and stormwater ordinances, etc.) that provide salmonid habitat with specific protections against development impacts. The regulations require that development occurring within a defined management zone be accomplished in such a way as to avoid and minimize development impacts and preserve essential biological functions for salmonids (see Executive Summary of the Model).

The Land Management Program is designed to serve as a model from which individual jurisdictions can create their own proposals for submission to National Marine Fisheries Service (NMFS) for a take limit under Limit 12 (municipal, residential, commercial, and industrial [MRCI] Development Limit) of the NMFS 4(d) Rule, or potentially, to the United States Fish and Wildlife Service (USFWS) for reduction or elimination of take prohibitions under a new or amended special rule for bull trout. It consists of three options that local governments can use individually or in combination to provide the necessary habitat protection for chinook salmon and bull trout. Local governments can use one, two, or all three options, which include (see Executive Summary of the Model):

1. A prescriptive set of regulations to be applied across an entire jurisdiction
2. A site-specific habitat evaluation process governed by a standard set of habitat goals and objectives consistent with protection of habitat function considered important for salmon recovery. The habitat evaluation is intended to result in habitat-protecting conditions unique to each development proposal.
3. A programmatic approach that allows a jurisdiction to perform a habitat evaluation for a specific geographic area or upon a distinct set of activities, resulting in a set of regulations tailored to those specific areas or activities.

Under the prescriptive regulations option, development proposals must comply with a standard set of development regulations (see Vol. 1, Chapter 2, pp.1-2 of the Model). This set of regulations prescribes inner and outer Management Zones (MZs) and development regulations for each zone designed to protect habitat functions from adverse effects of projects. An MZ is an area of real property that is immediately adjacent to a defined water body—fresh, brackish, or marine—and includes both aquatic and nearshore areas that either provide salmonid habitat or are important to the proper function of salmonid habitat, such

that the regulation of development on that real property is necessary. The fixed regulations option generally prohibits development activity in the area closest to the aquatic environment. A limited number of relatively minor actions (e.g., minor utility crossings, maintenance of flood control facilities) are allowed in this area if there are no other alternatives available that have less or no adverse environmental impacts, and impacts are mitigated with appropriate conservation measures. In these instances, a habitat evaluation must be used to determine what habitat functions will be affected and what mitigation and conservation measures will be required.

Under the site-specific habitat evaluation option, development proposals are reviewed based on a site-specific habitat evaluation of the habitat functions that are likely to be affected by the development proposal (see Vol. 1, Chapter 2, p.1 of the Model). The applicant is required to analyze the impacts of the development proposal and provide conservation measures consistent with the Land Management Program's habitat goals and objectives, which are designed to protect habitat functions and mitigate for impacts to those functions. Based on the results of the habitat evaluation, the local government will determine if the development proposal is approvable, depending on whether the proposal will impede the habitat objectives for that site. Where the habitat evaluation reveals that the project, as proposed, will have adverse impacts, the local government may either deny the project or require that the project be redesigned and/or its impacts mitigated to meet the habitat objectives. The scope and complexity of the habitat evaluation analysis and the required level of detail shall be commensurate with the scope of the project.

Under the programmatic regulations option, a city or county would conduct a habitat evaluation on a specific geographic area or specific type or category of development activity (see Vol. 1, Chapter 2, p.2 of the Model). Based on the results of the habitat evaluation, the jurisdiction will identify allowable activities and appropriate protection and mitigation measures, consistent with the goals and objectives of the Land Management Program. Appendix 2-G of the Model contains an example of a programmatic approach that was developed by the Urban Caucus of the Tri-County ESA Response Coalition (Seattle, Tacoma, Everett, and the ports therein). It is known as the *Built Area Option for Land Use Management* (BAO). The BAO uses a different approach to a programmatic habitat evaluation than the one described in the Land Management Development Regulations (see Executive Summary of the Model).

The Model exempts some development activities from its provisions. But while certain activities may be exempt from the provisions of the Land Management Program and, therefore, not subject to its regulatory provisions, they may still be subject to other local government regulatory programs. Some exemptions, such as maintenance of existing ornamental landscaping, allow specific existing uses to continue and be maintained, provided that there is no increase in the area affected and such activities follow existing environmental safety laws and standards. Other activities, such as an interior remodel, recognize that the activity is likely to have very minor or no impact on habitat. In addition, the Model recognizes that under some circumstances, the proposed regulations may result in denying a property owner reasonable use of his or her property. The Model includes guidance and criteria for local governments to follow to ensure that activities that are exempt or allowed as a reasonable use are conducted in the most habitat and fish friendly manner possible. See Chapter 2 of the Model and Chapter 4 of the biological review for further description.

The Model does not apply to agricultural activities. This is, in part, in recognition that Washington State is conducting the Agriculture, Fish, and Wildlife process to address the effects of agricultural activities on salmonid habitat. Also, jurisdictions regulate agricultural activities differently within Tri-County area, and some jurisdictions formally exclude agricultural activities from the definition of development. The Model would regulate other development activities on agricultural lands such as construction of residences, barns, or other large structures.

Apart from forest lands that are being converted to other uses, forest lands in the Tri-County region are subject to state or federal regulation, not local regulation (RCW Title 76; WAC Chapter 222; 36 CFR Part 221; 43 CFR Part 5000). As a result, neither the MRCI limit nor the Tri-County Land Management Program address forest management activities. Instead, the NMFS' 4(d) Rule for threatened salmonids provides a separate take limit (Limit 13) for non-federal forest practices subject to state regulation (50 CFR Section 223.203(b)(13)). USFWS has not promulgated a special rule to address non-federal forest management activities so those activities are subject to the prohibition on take of bull trout. Under Limit 13, prohibition on take of threatened Puget Sound chinook salmon does not apply to non-federal forest management activities in Washington, if those activities comply with forest practices regulations implemented by the Washington Forest Practices Board that NMFS has found are at least as protective of habitat functions as are the regulatory elements of the Forests and Fish Report submitted to the Washington State Forest Practices Board in April of 1999 (50 CFR Section 223.203(b)(13)(i)). Among other things, NMFS must also find that the activities are consistent with the conservation of listed salmonids' habitat by contributing to the attainment and maintenance of properly functioning conditions (PFC; 50 CFR Section 223.203(b)(13)(vi)).

At the direction of the State Legislature RCW 76.09.370(1); RCW 77.85.180(1)), in 2001 the Washington State Forest Practices Board adopted new permanent rules consistent with the 1999 Forest and Fish Report. Those rules are codified at WAC Chapter 222. NMFS has not determined whether those forest practices rules qualify for a take limit under Limit 13. This analysis assumes that those rules are sufficiently protective to qualify for that limit, and that state and private forest management activities conducted in the Tri-County region under those rules would, therefore, contribute to the attainment and maintenance of PFC in habitat for threatened Puget Sound chinook salmon and bull trout in the Tri-County region.

The Endangered Species Act (ESA) Section 7(a)(1) imposes a duty on federal agencies to use their authorities in furtherance of the ESA's purposes by carrying out programs for the conservation of listed species (16 USC Section 1536(a)(1)). Under ESA Section 7(a)(2), any federal agency that conducts federal forest management activities or authorizes private forest management activities on federal lands, such as the U.S. Forest Service or the Bureau of Land Management, must also consult with NMFS and USFWS (16 USC Section 1536(a)(2)). The purpose of the consultation is to ensure that the forest management activity is not likely to jeopardize the continued existence of listed species, or result in the adverse modification or destruction of designated critical habitat. The Matrix of Pathways and Indicators (MPI) used in this biological review was developed by NMFS and USFWS specifically for use in Section 7 consultations on timber sales on federal lands characterized by narrow, high-gradient headwater streams, such as the federal lands in the Tri-County region (see MPI discussion in Chapter 5). Based on the ESA Section 7 standards and the rigor of the MPI criteria, this analysis assumes that forest management activities conducted on federal lands in the Tri-County region will contribute to the attainment and maintenance of PFC in habitat for threatened Puget Sound chinook salmon and bull trout in the Tri-County region.

2.1.2 Stormwater Management Program

The Stormwater Management Program is a comprehensive, integrated program of planning, regulation, capital projects, and education designed to better protect and restore chinook salmon and bull trout habitat from the stormwater-related impacts of past and future development (see Section 4.3.2 for more information). It is designed to achieve both ESA and Clean Water Act (CWA) objectives. The program is also designed to serve as a model from which individual jurisdictions can create their own proposals for submission to NMFS for a take limit under Limit 12 (MRCI Development Limit) of the NMFS Final 4(d) Rule (see Executive Summary of the Model), or potentially to the USFWS for reduction or elimination of take prohibitions under a new or amended special rule.

2.1.3 Regional Road Maintenance ESA Program Guidelines

Although the regional program is included in the Model, it is a statewide program, submitted separately to the Services. A separate, statewide biological review has been conducted to evaluate the impact of the program on threatened aquatic species and it is hereby incorporated by reference (Regional Road Maintenance ESA Forum 2002b). The Biological Review of the Regional Road Maintenance ESA Program Guidelines text is included on compact disk inside the back cover of this document.

NMFS has published its intent to approve the statewide program under Limit 10 of the 4(d) Rule.[13] USFWS is also evaluating the program to determine if a special 4(d) rule should be promulgated to eliminate the take prohibition on bull trout for agencies in Washington State that implement the regional program.

The Tri-County Road Maintenance ESA Technical Working Group, a team of local road maintenance managers and technical staff, was formed under the Tri-County response effort. The mission of the Group was to develop a road maintenance program that would contribute to the conservation of salmonids and other fish species as well as meet the requirements of federal agencies under Section 4(d) of the ESA (see below). At the same time the Tri-County effort was getting underway, the Washington State Department of Transportation (WSDOT) was developing its own road maintenance program, which focused on the same goals as the Tri-County Road Maintenance ESA Technical Working Group.

The Tri-County Road Maintenance ESA Technical Working Group quickly expanded its scope to include counties and cities outside the Tri-County area. WSDOT also became an active and vital member of the Group. The Group was renamed the Regional Road Maintenance Technical Working Group to reflect the growing interest and participation in this program. In the fall of 2001, after 2 years of collaborative effort developing the regional program and the WSDOT road maintenance program, WSDOT formally considered the Group's program part of the regional program. This decision expanded the regional program to include all of Washington State.

To assist local governments in implementing the road maintenance program, and to provide the NMFS and USFWS (Services) with a thorough document against which regional program compliance could be evaluated, the Regional Road Maintenance Technical Working Group developed the Regional Road Maintenance ESA Program. The Services and other regulatory authorities, as well as Puget Sound area Tribes, environmental interest groups, and business groups, also provided input and assistance into development of the Regional Road Maintenance ESA Program Guidelines, which includes the following three parts:

- **Part 1: Regional Program Elements** provides the basic framework for the Regional Road Maintenance ESA Program. There are 10 program elements, and implementation of all 10 is required for a local agency to obtain a 4(d) take limit from NMFS or a reduction or elimination of the take prohibition from USFWS. Descriptions of the program elements, and their contribution to conservation of listed species, are contained in Section 2.2.3 of this biological review.
- **Part 2: Best Management Practices** includes a set of site-specific best management practices (BMPs) for road maintenance. Under the Regional Road Maintenance ESA Program Guidelines, road maintenance, environmental, and engineering design staff can use these BMPs, in addition to

[13] The Regional Road Maintenance Program has been submitted to NMFS under a separate 4(d) rule take limit, Limit 10. NMFS published notice of availability and request for comments on the submittal in the Federal Register at Volume 65, No. 17, p.3688 (January 25, 2002). As a result, the Regional Road Maintenance ESA Program Guidelines may be implemented as a stand-alone program separate from the stormwater and land use programs. This program has a Monitoring and Adaptive Management component, but does not require participation in the WRIA planning or Habitat Funding programs.

routine BMPs presented in Part 1, to achieve conservation outcomes identified in the program. Because state regulations and local ordinances, or site-specific permit conditions, may dictate the use of specific BMPs, Part 2 offers a menu of possible BMPs from which the most suitable method of maintenance activity can be selected.

- **Part 3: Application** is an individual agency application for 4(d) take limits under the regional program. The Part 3 Application, known as the "plug-and play" part of the regional program, allows local agencies to "plug" into Parts 1 and 2 of the program to receive 4(d) take limits. The Part 3 Application is a specific commitment from an agency that it will comply with the 10 program elements in Part 1 (Regional Road Maintenance ESA Forum 2002a).

2.1.4 WRIA Based Planning Program

The WRIA Based Planning Program is a comprehensive, ecosystem-based program to develop, implement, and monitor actions intended to improve habitat conditions for salmonids. This program includes the following two major action elements (see Executive Summary of the Model):

- A Near-Term Action Agenda, to identify actions feasible in the near term and to prepare for long-term actions, and
- Salmonid Conservation Planning, to develop a plan for longer-term actions that contribute to the future health and sustainability of salmonids.

This program, which is based on scientific assessment of the unique characteristics of each watershed and the effects of historic and current development, involves watershed stakeholders in decisions to prioritize habitat investments and other actions. A key role of watershed planning is to monitor salmonid conservation results in each watershed and help coordinate adaptive management decisions. Watershed based planning has been organized within state designated Water Resource Inventory Areas (WRIAs; WAC 173-500).

2.1.5 Monitoring and Adaptive Management Program

Each Model program must be monitored and adapted over time as scientific understanding evolves. The Model provides a long-term commitment to monitor outcomes, evaluate successes and failures, and recommend needed course corrections. It also recognizes that additional implementation steps will be necessary to the success of a Monitoring and Adaptive Management Program that are not detailed in the Model itself (see Attachment 1 to Chapter 6 of the Model). The following three types of monitoring support the adaptive management strategy (see Executive Summary of the Model):

- Compliance Monitoring: Each jurisdiction or entity seeking a take limit or other assurances under ESA 4(d) must demonstrate that it will comply with NMFS or USFWS 4(d) Rule requirements. Compliance monitoring is a tool to ensure that jurisdictions are implementing the actions they committed to.
- Effectiveness Monitoring: The effectiveness of all programs, including those that are properly implemented, must be measured to determine whether desired results occur and whether salmonid habitat objectives are, in fact, being achieved as expected.
- Validation/recovery monitoring: Validation or recovery monitoring is designed to answer the question, "Are management strategies on track to achieve salmonid recovery overall?" This is the most challenging type of monitoring because it involves analyzing the results of all public and private actions to protect habitat throughout the Puget Sound region, not just the efforts of local governments.

This program would be implemented in addition to adaptive management and monitoring elements that are tailored to and included in all other Model programs (Land Management Program, Stormwater Management Program, Road Maintenance Program Guidelines, and Habitat Acquisition and Restoration Funding Program).

2.1.6 Habitat Acquisition and Restoration Funding Program

This program will augment regulations by providing funding for the acquisition and restoration of habitat that has a current or potential high value for salmonids to ensure that critical spawning and rearing habitat and migration corridors are available to sustain existing salmonid populations as well as to protect other fish and wildlife species. The Habitat Acquisition and Restoration Funding Program will also fund strategic habitat restoration to rebuild or restore isolated or degraded habitat in the watersheds of participating jurisdictions (see Executive Summary of the Model).

The cornerstone of this program is a commitment from each participating jurisdiction to annually dedicate at least 1% of its capital budget to habitat acquisition and/or capital projects with habitat benefits for salmonids. The funding commitment will provide certainty that participating jurisdictions make an adequate financial commitment (see Executive Summary of the Model) to:

- Continue the current high level of habitat project implementation,
- Implement the most effective projects and programs, and
- Refocus their habitat acquisition and restoration programs, as necessary, to respond to new information about salmonid needs and monitoring results (see Executive Summary of the Model).
- Jurisdictions will calculate their 1% commitment based on their total capital budget of the previous year, including all local and regional funding and funding for research, acquisition, facility construction, repairs and retrofitting, project impact mitigation, and purchases of major equipment. Each participating jurisdiction shall be responsible for allocating the funds generated by its 1% funding commitment. Funding allocation decisions shall be informed by WRIA-level conservation planning efforts in the short term (phase 1; prior to the completion of such plans) and, in the long term, be consistent with WRIA-level plans following their adoption (phase 2). The Habitat Acquisition and Restoration Funding Program allows fund allocation to projects that expressly or exclusively benefit salmonid habitat (category 1) and/or to projects have salmonid benefits ancillary to their principal purpose (category 2).
- The following criteria would have to be met for any project or portion of a project to be creditable toward the 1% commitment. All projects would have to occur in an area that adjoins or is hydrologically connected to a salmon-bearing stream, river, estuary, or marine water body, and either:
- Improve the physical condition of the freshwater, riparian, estuarine, or marine habitat along the water body, or
- Improve hydrologic, sediment, water quality or biological conditions, or habitat-forming processes or functions that contribute directly to enhance salmon habitat in the water body.

Jurisdictions could claim full credit toward the 1% funding requirement for category 1 projects, and jurisdictions could claim that portion of a category 2 project that contributes directly to salmonid recovery. For example, if only 60% of the cost of a road project was dedicated to road safety and 40% was dedicated to correcting a fish passage barrier (and meets the above criteria), 40% of the project costs would be creditable toward the 1% funding commitment. Under all circumstances, costs for mitigating construction-related impacts would be ineligible for credit toward the 1% commitment.

The Tri-County Funding Program defines an annual process for reviewing the funding program, including a tally of projects implemented in the prior year, determination of the appropriate level of funding for the coming year, and an accounting of actual versus planned expenditures for habitat projects for the prior fiscal year. If actual expenditures fall short of the 1% level, the shortfall would be added to funding for the coming year. If the reverse occurs, money would be deducted from funding for the coming year.

Monitoring of results and adaptive management will be used to refocus habitat funding where indicated (see Executive Summary of the Model).

2.2 ECOLOGICAL FRAMEWORK OF THE MODEL

The Model addresses all salmonids in an attempt to avoid future listings of additional species. It acknowledges the diverse circumstances of many large and small jurisdictions, but also strives to conserve all salmonids, with an emphasis on listed species. It also attempts to protect habitat of value to multiple species of salmonids. The Model is premised on the following three assumptions (see Executive Summary of the Model):

1. The Model must contribute to the conservation of listed salmonids.
2. The Model's land management regulations cannot permit development activities that would excessively impact a listed species.
3. The Model cannot permit development activities that would prematurely foreclose habitat restoration opportunities and prevent future recovery of listed species.

Each program of the Model was developed based on an ecological framework tailored by subject matter. The framework of each program is addressed below and evaluated in Chapter 4 of the biological review for consistency with the NMFS 1996 Coastal Salmon Conservation guidance document (NMFS 1996).

2.2.1 Land Management Program

The fundamental biological principle upon which the Land Management Program is based is "to achieve the abundance, distribution, and genetic life-history diversity needed for recovery and sustainability of harvestable levels of the species." Based on this fundamental principle, the Land Management Program has the following biological goals (see Appendix A of the Model):

Biological Goal 1: To maintain, if adequate, and restore, if inadequate, the survival rates, number, and individual size characteristics at each life history stage.

Biological Goal 2: To maintain, if adequate, and restore, if inadequate, the natural geographic and temporal distribution at each life stage within the natural range of the species.

Biological Goal 3: To provide the opportunity for full expression of natural diversity (and by inference, genetic diversity) of the species' life history strategies.

Biological Goal 4: To maintain, if adequate, and restore, if inadequate, the biological communities that support recovery and sustainability of the species.

To achieve these goals, it will be necessary to maintain and restore habitat functions and values for salmonids and their associated biological communities. Control of exotic species will be needed as well, particularly to meet goal 4.

Specific habitat objectives were formed based on these biological goals, with the overall habitat goal being to provide for the habitat access, structure, and process necessary to achieve the biological goals. These habitat objectives include (see Appendix A of the Model):

Habitat Objective 1: To provide for appropriate access for unimpeded movement of salmonids during all life history stages within and among all appropriate habitats within their historic range and not to artificially modify natural barriers to upstream areas that are not in their natural range.

Habitat Objective 2: To provide structural habitat through appropriate natural channel or wetted basin form and process.

Habitat Objective 3: To provide for habitat-forming processes crucial to maintaining and restoring aquatic and edge habitats.

2.2.2 Stormwater Management Program

The Stormwater Management Program has an immediate focus, which is to prevent further harm from stormwater in sub-basins where the potential for harm is the highest and the opportunity for mitigation is the greatest (i.e., in sub-basins undergoing urbanization as opposed to sub-basins already fully developed). The program, however, also focuses on enhancing habitat conditions in essential habitat, regardless of the level of build out through stormwater planning and capital improvement programs. This approach has two purposes: (1) to address harm caused by past development that occurred without mitigation or with mitigation that was inadequate by modern standards, and (2) to offset the residual impacts of future urbanization.

The immediate focus of the Stormwater Management Program on urbanizing sub-basins is based on the following scientific findings (see Volume II, Chapter 3 of the Model):

- A root cause of degraded salmonid habitat is flow regimes that have been altered from the natural state by increases in effective impervious surfaces, and
- In urbanized basins, sub-basins or watersheds, unalterably high effective impervious surface areas probably preclude restoration of the natural processes that defined predevelopment flow regimes.

This program includes a Stormwater Management Checklist, which identifies the following goals and objectives for each of the 14 programmatic elements that jurisdictions must adopt, fund, and implement (see Volume II, Chapter 3, Checklist Attachment A of the Model):

- Minimize adverse impacts resulting from area zoning and land use regulations and policies.
- Mitigate adverse stormwater impacts that may result from land use decisions and improvements (including capital improvements) by requiring compliance with land development practices, stormwater facilities, and BMPs through permit conditions or other local government mechanisms to approve proposed development and construction activities.
- Ensure proper application of and compliance with adopted regulations and standards (e.g., technical standards, reduction of illicit discharges, land use regulations, etc.) so they are effective in mitigating adverse stormwater impacts.
- Ensure that public and private stormwater control facilities are properly maintained so they continue to be effective in mitigating adverse stormwater impacts.
- Control pollutants at the source on developed sites so they do not contact or mix with stormwater runoff.

- Detect, remove, and prevent illicit discharges from commercial, industrial, and residential sites through regulations, inspection, and enforcement.
- Change behaviors and practices that cause or contribute to adverse stormwater impacts to minimize and eventually eliminate such impacts.
- Increase public awareness of and participation in jurisdictional decisions and activities related to stormwater management, including impact elimination, avoidance, and minimization.
- Coordinate stormwater-related policies, programs, and projects among jurisdictions sharing responsibilities for similar programmatic activities within a watershed and coordinate among departments sharing similar responsibilities within each jurisdiction.
- Collect and compile information needed to document and certify performance of programmatic activities required to comply with the Model program and any 4(d) coverage a jurisdiction may receive based on that program.
- Periodically collect key information on the biological, physical, and chemical aspects of aquatic habitat and use that information to assess and improve the effectiveness of policies, regulations, standards, programs, and projects over time.
- Ensure that stormwater plans and studies are conducted, as needed, to support other programmatic elements; that these planning efforts are coordinated among jurisdictions, departments, and other entities within the same watershed or basin; and that jurisdictions will participate in watershed planning efforts to identify, protect, and restore aquatic species and their habitats at the local, WRIA, and evolutionarily significant unit (ESU) level.
- Construct facilities or improvements that mitigate adverse stormwater impacts from past, present, and future development.
- Recover or rehabilitate instream habitat to compensate for habitat lost or degraded by the incremental or cumulative stormwater impacts of development and other human activities.
- Acquire and manage lands to eliminate, avoid, and minimize the hydrologic impacts of development and other human activities on freshwater riverine and stream habitats and species, and protect and restore ecosystem processes that create and maintain habitats used by salmonids for spawning and freshwater rearing and migration.
- Acquire and manage lands to eliminate, avoid, and minimize the potential for decreases in stream base flows and increases in storm flows caused by development and other human activities.

2.2.3 Regional Road Maintenance ESA Program

The aim of the Regional Road Maintenance ESA Program is to conserve habitat and contribute to PFC while performing road maintenance activities. A Regional Forum has been created from participating agencies to provide a regional meeting for program discussion, coordination, and adaptive management. The Regional Forum recognizes that there is risk of adverse impacts from road maintenance activities, and it includes built-in mechanisms to improve BMPs over time, avoid errors or BMP failures, and minimize impacts should errors or failures occur. This adaptive management approach is accomplished by combining Program Elements 1 – 9 with Program Element 10 (described below). The other elements help to minimize the risk of adverse habitat impacts through an integrated process of training, monitoring, and adaptive management; tracking the effectiveness of maintenance BMPs; and improving practices as needed. A brief description of each program element, and its contribution to conservation of listed species, is provided below:

Element 1 - Regional Forum: A regional forum has been created from participating agencies to provide a regional meeting for program discussion, coordination, and adaptive management. In terms of contributing to conservation, the regional forum provides a process whereby as new information is gathered in each individual agency, it can be shared with other agencies across the state. Sharing information on successful BMP applications in the field, together with scientific research, creates a potential for each agency to improve its contribution to conservation over time. Additionally, if a problem with program implementation occurs in one jurisdiction, this information sharing prevents repeated problems.

Element 2 – Program Review and Approval: The program review and approval process will require that each agency participating in the regional program comply with the 10 program elements. The goal of the program review and approval process is to establish consistency across Washington State so conservation measures are achieved.

Element 3 - Training: Training courses will include topics on basic ESA, design, biological review, permit activities, maintenance BMPs, and monitoring work activities. The Services will approve the training courses. Thorough training on all elements of the regional program at applicable levels of implementing agencies provides consistency across the state so conservation goals can be met.

Element 4 – Compliance Monitoring: The objective of compliance monitoring is to evaluate program implementation to accomplish regional program conservation goals consistently across the state. Compliance monitoring will take place at several levels: local agency supervisory staff, local agency permitting authorities, and state and federal permitting authorities evaluating BMPs for use and implementation. Each local agency will establish a formal compliance monitoring program for monitoring BMP outcomes and any monitoring that is part of various research projects.

Element 5 – Scientific Research: Case studies in the field, as well as literature research, are included in this program element. Scientific research will serve to verify effectiveness of BMPs and update BMPs based on the latest technologies. Conservation opportunities can be maximized using information derived from this element.

Element 6 – Adaptive Management: The adaptive management philosophy will apply to all 10 regional program elements. The training, research, biological data collection, and program monitoring elements are the basis for adaptive management. Adaptive management provides a means by which potential adverse impacts are avoided and minimized, and conservation opportunities are maximized, as the regional program is implemented throughout Washington State.

Element 7 – Emergency Response: This element provides a framework under which road maintenance organizations can operate during emergencies. It allows for necessary emergency response measures, while keeping the Services and regulatory agencies apprised.

Element 8 – Biological Data Collection: This element includes habitat location information within the right-of-way (ROW) and development of a process to train and alert staff where the Road Maintenance Guidelines need to be applied.

Element 9 – Biennial Reports: The Regional Forum will provide biennial (every 2 years) reports to the Services that will include review of the 10 program elements, updates on research, recommended BMP changes, and recommended updates on each program element.

Element 10 –BMPs and Conservation Outcomes: Under the regional program, BMPs and desired conservation outcomes have been developed for road maintenance activities. The Regional Forum

will annually review and update the BMPs. Local agencies and the Services will review changes the Regional Forum recommends for adoption (Regional Road Maintenance ESA Forum 2002a).

2.2.4 WRIA Based Planning Program

The framework for WRIA based planning describes a collaborative, strategic approach to identify, prioritize, and implement near- and long-term salmonid conservation and recovery actions within watersheds (see Volume III, Chapter 5 - Program Overview of the Model). The stated purpose of watershed based planning is "to advance the Tri-County goal of recovering salmonid species to sustainable, harvestable population levels."

Watershed based planning efforts are intended to yield the following multiple benefits (see Volume III, Chapter 5 - Program Overview of the Model):

- Customized, watershed based biological and ecological assessments that will serve as the science-based foundation for early- and interim-action identification and other decision-making;
- Strategic, watershed based species and habitat information critical to both the identification, prioritization, and implementation of cost-effective, science-based actions as part of watershed based conservation and recovery effort, and to the development and implementation of comprehensive recovery plans at the ESU scale by the co-managers (i.e., state and Tribal governments) and federal agencies.
- Multi-jurisdictional, multi-stakeholder watershed groups to guide local and regional watershed planning and action and support similar efforts by state, federal, and tribal governments at the ESU scale.
- Active and broad involvement and participation by key stakeholder groups and citizens, leading to strong, grass-roots support for salmonid recovery.
- Both information and institutional mechanisms to support collaborative fundraising efforts in support of early- and longer-term actions.
- Established mechanisms for direct input from federal and state agencies and tribal governments into watershed based planning and action and for feedback from local stakeholders to the co-managers and the Services.

The WRIA Based Planning Program is founded on the following principles (see Volume III, Chapter 5 – Program Overview of the Model):

- Ecosystem processes critical to the sustainability of salmonids (and other aquatic species) occur at spatial scales greater than that of individual programs or jurisdictions and at varying time scales.
- The benefits of coordinated and collaborative action among jurisdictions within a watershed to protect and restore ecosystem processes and habitat are greater than that of actions taken in isolation, for both listed species and the jurisdictions.
- Watershed based salmonid conservation plans are ecosystem-based and multi-species in scope.
- The plans will provide consistent information across watersheds that will allow for cross-WRIA comparisons and priority setting. Cross-WRIA consistency is essential for individual plans to inform and integrate with ESU-level recovery planning efforts by the Services and state co-managers.

To ensure that WRIA plan recommendations are based in science, WRIA technical committees would be convened and composed of qualified technical experts. These committees would engage in the following activities (see Volume III, Chapter 5 – Attachment 2 of the Model):

- Provide scientific expertise to conduct and review watershed assessments (as described in the Model Planning Framework), and
- Recommend actions to conserve and restore salmonid habitat based on the assessments.

The Model also includes a Watershed Assessment Framework, under which all WRIA planning groups can find guidance as they craft their respective technical programs in an adaptive management context. The framework would guide WRIA groups in tailoring technical programs to species, habitat factors, and resource availability particular to the given watershed and generate information necessary to support actions related to Near Term Action Agendas, Salmon Conservation Plans, and the non-watershed planningelements of the Model (Land Management, Stormwater Management, Regional Road Maintenance, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding). The framework is based on the following initial assumptions (see Volume III, Chapter 5 – Attachment 3 of the Model):

- Sustainable salmonid populations require a healthy, functioning ecosystem, and that we can define with increasing clarity what constitutes a healthy, functioning ecosystem.
- Taking action in the near-shore marine, estuarine, and freshwater portions of the salmonid ecosystem is a necessary element in efforts to recover listed species to sustainable, harvestable population levels.
- WRIA based planning is the best vehicle for: (1) identifying, implementing, and monitoring habitat actions leading to conservation and eventual de-listing, and (2) providing technical information to interim compliance measures.
- Decision-making in the WRIAs will emphasize actions that achieve benefits for multiple species.
- Information on key fish life history, habitat/ecosystem, and human use factors exists in all WRIAs.
- Taking habitat protection and restoration actions defined at the watershed, sub-watershed, and reach scales will enhance salmonid populations more effectively than actions identified only at the jurisdictional level.
- Conservation and recovery actions will rely on watershed assessment findings and will be developed, implemented, and monitored through both collaborative and individual action.
- Moving from the findings of the watershed assessment to action implementation will require merging opportunities from both the technical and policy realms.
- Resources for data collection, data analysis, action implementation, and monitoring will be limited in the near and long term.

The conceptual approach for the Watershed Assessment Framework specifically considers NMFS 1996 habitat objectives (NMFS 1996). Accordingly, the framework is attentive to geographic scale, temporal scale, and causal relationships and incorporates habitat/ecosystem, fish use, and human use perspectives. The goals of the framework assessments are to (see Volume III, Chapter 5 – Attachment 3 of the Model):

- Identify the critical biological, physical, and chemical conditions in the watershed that most strongly influence the freshwater and nearshore sustainability of salmonids.

- Characterize current and historic conditions throughout the watershed, with respect to their ability to support salmonids during freshwater and nearshore life history stages.
- Enhance understanding of the causal relationships between landscape-scale watershed conditions, specific habitat factors, and salmonid sustainability.
- Build understanding of causal relationships between human uses of the watershed and habitat qualities of the watershed to refine current and future land uses to support salmonid protection and restoration.
- Establish the technical basis for the definition of measurable conservation objectives, priority actions, and monitoring efforts.
- Identify, prioritize, and recommend both short- and long-term opportunities for conservation and recovery action.

The WRIA Based Planning Program also incorporates principles to guide the Monitoring and Adaptive Management Program.

2.2.5 Monitoring and Adaptive Management Program

The Monitoring and Adaptive Management Program recognizes that the science of chinook salmon and bull trout recovery is evolving, and actions taken under the 4(d) rule programs or through watershed planning may need to be modified over time. It is anticipated that implementation of this program will result in the following outcomes (see Volume III, Chapter 6 of the Model):

- Knowledge of ecosystem processes and functions is increased.
- Roles and responsibilities are clearly defined, predictable, and can be understood by managers as well as stakeholders.
- Relevant information is gathered, using appropriate quality controls, and is coordinated to evaluate management decisions and actions at the local, watershed, and regional scales.
- Institutional course corrections occur at predetermined milestones to ensure continual progress toward specific, measurable species recovery goals and habitat objectives.
- Institutional environments are improved as necessary, and ecosystem functions and processes are protected and restored.

The following principles represent the foundation of the Monitoring and Adaptive Management Program (see Volume III, Chapter 6 of the Model):

Precautionary principle:. In the absence of certainty, an environmentally protective approach should be taken.

Ecosystem understanding: Management decisions should be consistent with current understanding of ecosystem processes and functions.

Flexibility: Management systems should be dynamic and flexible enough to respond effectively to changes in the natural systems.

Stakeholder investment: The Tri-County approach should gain essential stakeholder participation, agreement, and commitment. Stakeholders should make a long-term commitment to the process, recognizing that salmonid recovery is a long-term undertaking.

2.2.6 Habitat Acquisition and Restoration Funding Program

The Habitat Acquisition and Restoration Funding Program consists of commitments to fund capital projects to protect, enhance, and restore salmonid habitat in ways that may not or cannot be accomplished through regulatory programs or by other means (see Volume III, Chapter 7 of the Model). The purpose of the program is twofold: (1) To offset residual impacts to chinook salmon and bull trout habitat associated with day-to-day land use activities, and (2) to undertake a sustained program to preserve and restore important salmonid habitat. This program will complement other elements of the Model by providing for the acquisition and management of high-quality, critical habitat. The key role of the program is to provide certainty that participating jurisdictions will make an adequate financial commitment to (see Volume III, Chapter 7 of the Model):

- Continue the current high level of habitat project implementation,
- Implement the most effective projects and programs, and
- Refocus the program, as necessary, to respond to new information about salmonid needs and monitoring results.

Science-based adaptive management processes outlined in the Monitoring and Adaptive Management Program of the Model are incorporated into the Habitat Acquisition and Restoration Funding Program.

3. OVERVIEW OF ASSESSMENT METHODOLOGIES

Chapter 3 provides an overview of the assessment methodologies as well as assumptions and definitions used in Chapters 4 through 8 of this biological review to evaluate and determine the effects of the early- and long-term Tri-County Model 4(d) Rule Response Proposal (Model) programs. The details of specific methodologies are provided in subsequent chapters and, where appropriate, additional methodologies and analyses distinct to specific program components are presented in appendices. To facilitate review, this chapter includes the following sections:

3.1 Assumptions and Definitions

3.2 Consistency of the Model with Federal Guidance and Scientific Literature – Chapter 4

3.3 Analysis of Model Effects on Selected Sub-Basins– Chapter 5

3.4 Individual Effects of Model Programs – Chapter 6

3.5 Synergistic Effects of Model Programs – Chapter 7

3.6 Analysis of Long-Term Programs

3.6.1 WRIA Based Planning Program

3.6.2 Monitoring and Adaptive Management Program

3.6.3 Habitat Acquisition and Restoration Funding Program

3.1 ASSUMPTIONS AND DEFINITIONS

Assumptions used in this biological review include:

- The Model will be applied across the entire Tri-County region. This assumption is probably unrealistic because it is not known with any certainty which, if any, jurisdictions will choose to implement the Model in its entirety, therefore, it is impossible to predict the exact extent and nature of application of the Model. However, assuming region-wide application provides a baseline for understanding the potential effects of hypothetical region-wide implementation or realized deviations from region-wide application.
- The outcome of the Model programs or program elements that are not strictly prescriptive (e.g., inspection, review, enforcement, planning procedures, and design principles) will rely on equally full and effective implementation by participating jurisdictions. This biological review assumes that jurisdictions will establish mechanisms for implementing these elements fully and effectively when applying for the National Marine Fisheries Service (NMFS) municipal, residential, commercial, and industrial (MRCI) Limit coverage and/or coverage under a future U.S. Fish and Wildlife Service (USFWS) Special Rule.
- Implementation of programs and program elements will be at the general level proposed in the Model. All aspects of the implemented program will be included by the jurisdiction at the scale and time frame proposed in the program. These analyses identify situations where this general assumption is questionable.
- Properly functioning conditions (PFC) for chinook and bull trout have not yet been defined for many of the habitat types (low gradient small to mid-size streams, large rivers, estuaries, and near-shore marine areas) covered by the Model. Specific metrics and values for each parameter within the various matrix categories have not been adequately defined for many habitat types. Therefore, we have applied the NMFS Matrix of Pathways and Indicators (MPI) (NMFS 1996) developed for forested headwater streams throughout the freshwater portions of the chinook

salmon habitat. However, use of the MPI to assess the habitat types covered by the Model may underestimate existing habitat values and functions, as well as the effects of habitat protection or restoration that would occur through implementation of the Model.

- Existing habitat conditions in most of the developed portions of the Tri-County area are most likely not currently at PFC as defined by NMFS. Our evaluation of the effects of the Model does not include sufficient information to determine if PFC will be reached. We can, however, determine the presence or absence of habitat changes with application of the Model and the direction that habitat changes would take (restore or degrade).
- Maintaining or reaching PFC for chinook salmon will generally assure that adequate conditions are present for migrating bull trout in mainstem stream reaches and foraging habitat in Puget Sound.

This biological review attempts to identify or predict the types of effects the Model is likely to have on existing habitat conditions and functions. For the purposes of the analyses in all chapters except the sub-basin analysis in Chapter 5, the effects of the Model programs are defined as:

- Improve: to move the condition of an indicator on a trend toward PFC, but does not necessarily mean that PFC will be attained.
- Maintain: to keep an indicator at approximately its current condition.
- Degrade: to cause the condition of the indicator to decline from its current condition (PFC or otherwise).

In Chapter 5, the NMFS definitions for the terms "restore," "maintain," and "degrade" are applied in the MPI[14]. The sub-basin analysis in Chapter 5 assesses the combined effects of the Model programs to predict whether the Model will restore, maintain, or degrade each PFC indicator sufficiently to change the baseline condition from one MPI category to another. In Chapter 5, the baseline and predicted future MPI categories are stated explicitly.

The types of predicted Model effects are characterized throughout this biological review by qualifying terms where applicable. Understanding the differences among the types of effects is important to understanding the applicability and extent of those effects. The following definitions apply to the terms used to qualify effects throughout the text:

- Primary effect: a strong effect (positive or negative) resulting from implementation of a program or program element, with effects expected to be one or more orders of magnitude greater than a secondary effect.

[14] NMFS (1996) defines these terms according to whether they are sufficient to move from one MPI category to another:

- *Restore*: means to move the baseline condition from one MPI category to another in a positive direction (not properly functioning to at risk, or at risk to properly functioning).
- *Maintain*: means to keep an indicator at its current baseline condition whether not properly functioning, at risk, or properly functioning.
- *Degrade*: means to move the baseline condition from one MPI category to another in a negative direction (properly functioning to at risk, or at risk to not properly functioning).

- Secondary effect: a weak effect (positive or negative) resulting from implementation of a program or program element, with effects expected to be one or more orders of magnitude less than a primary effect.
- Substantially addresses: the Model or Model program appreciably addresses a NMFS 4(d) Rule consideration for MRCI development and redevelopment.
- Partially addresses: when describing a program's or the Model's conformance with a MRCI consideration, the Model or Model program addresses a portion of a NMFS 4(d) Rule MRCI consideration, but its overall performance against the consideration is not conclusive.
- Individual effect: an effect (positive or negative) resulting from an individual action, program, or program element.
- Synergistic effect: the combined effects of multiple programs, whether the effects are additive or greater than the sum of individual effects.

The individual program effects were evaluated only for the Stormwater Management and Land Management Programs, because they recommend discrete actions that have the potential to affect habitat. The individual program effects of the Regional Road Maintenance ESA Program Guidelines are evaluated in a separate biological review and are only evaluated herein with respect to synergistic effects (Regional Road Maintenance ESA Forum 2002b)[15]. The roles of the Habitat Acquisition and Restoration Funding, Monitoring and Adaptive Management, and Watershed Based Salmonid Planning Programs (long-term action programs) are discussed throughout the document, where applicable. The methodologies for evaluating these long-term programs are provided in this chapter.

3.2 CONSISTENCY OF THE MODEL WITH FEDERAL GUIDANCE AND SCIENTIFIC LITERATURE – CHAPTER 4

Section 4.1 assesses whether, and the extent to, the ecological goals of the Model are consistent with the objectives of NMFS' Coastal Salmon Conservation: Working Guidance for Comprehensive Salmon Restoration Initiatives on the Pacific Coast (NMFS 1996). This guidance document provides direction for a comprehensive salmon restoration plan. Though the Model is not intended to be a comprehensive salmon restoration plan, it contains programs and elements that support restoration of salmonid habitat, and ultimately, recovery of listed species.

USFWS has not developed PFC for lower river migratory corridors and Puget Sound rearing conditions. To address these issues, we have included information from the interim guidance provided by USFWS (1998c) and other scientific publications. These references, and relevant information, are presented in detail in Section 4.2.

Section 4.3 uses scientific literature to assess the merits of the Model programs with respect to the technical concepts that the programs address or upon which they are based.

3.3 ANALYSIS OF MODEL EFFECTS ON SELECTED SUB-BASINS – CHAPTER 5

A sub-basin analysis was used to identify the likely effects of the Model on salmonid habitat in streams representing a range of conditions found within the developing portions of the Tri-County area. The

[15] The Biological Review of the Regional Road Maintenance ESA Program is included on compact disc inside the back cover of this report and can be found at http://metrokc.gov/roadcon/bmp/pdfguide.htm.

habitat elements addressed are those defined in the NMFS MPI for salmon (NMFS 1996) and the USFWS MPI for bull trout (USFWS 1998a). This analysis specifically evaluated the effects of applying the Stormwater Management and Land Management Programs on six selected sub-basins.[16] In addition, the sub-basin analysis generally discusses the role of the Habitat Acquisition and Restoration Funding, Monitoring and Adaptive Management, and Watershed Based Salmonid Conservation Planning (WRIA Based Planning) Programs in contributing to salmonid recovery.

The sub-basins selected for this analysis include Soos Creek, the Middle Green River, Newaukum Creek, Hamm Creek, Longfellow Creek, and the Lower Duwamish River (Figure 3-1). They are located in the Green River Basin (Watershed Resource Inventory Area [WRIA 9]) and were selected based on the completeness of data in the WRIA 9 Limiting Factors Analysis (LFA) Report (King County and Washington State Conservation Commission [WSCC] 2000), the consistency of the LFA data with habitat classifications defined in the MPI (National Oceanic and Atmospheric Administration [NOAA] 1996; USFWS 1998a), and because of the range of existing conditions that they represent within WRIA 9. Determinations of sub-basin baseline habitat conditions were evaluated relative to PFC, based on conclusions or information contained in the WRIA 9 Limiting Factors Analysis Report (King County and WSCC 2000). Baseline conditions were classified as properly functioning, at risk, or not properly functioning, as defined in the MPI. Effects were determined to improve, maintain, or degrade (see definitions in Section 3.1) the baseline conditions in short (5 to 20 year) or long (50 to 100 year) timeframes, with the assumption that if the effects of a program or program element effect were realized in the short timeframe, then it would also be realized in the long timeframe.

The synergistic effects of the Model programs were determined for each sub-basin by evaluating the combined effects of the programs and program elements within selected sub-basins on each PFC indicator. The analysis predicts whether application of the Model will improve, maintain, or degrade baseline conditions.

While each of the sub-basins is located in a single watershed within King County, the analysis should be applicable to sub-basins and streams with similar habitats and land uses throughout the Tri-County area. The similarity of the selected sub-basins to other Tri-County sub-basins, with respect to land use characteristics and species use, was compared and discussed. Based on the determinations of the sub-basin analyses and the similarity of the selected sub-basins to other Tri-County sub-basins, the potential for individual Model programs to effectively address populations of listed chinook salmon and bull trout in the Tri-County region is discussed in this chapter.

3.4 INDIVIDUAL EFFECTS OF MODEL PROGRAMS – CHAPTER 6

Because the analysis in Chapter 6 does not apply to a specific sub-basin or stream, baseline conditions are not defined and are not available for a determination of at risk, properly functioning, or not properly functioning. Therefore, the analysis presented in this chapter assesses whether the individual Model programs would be expected to generally improve, maintain, or degrade existing chinook salmon and bull trout habitat indicators (see definitions in Section 3.1).

In some cases, we note where a program affects a PFC indicator, but the program alone would not improve, maintain, or degrade the condition of the indicator. In these cases, we state that the program would contribute toward a specific effect.

[16] The likely effects of the Regional Road Maintenance ESA Program Guidelinesacross the Tri-County region are contained in a separate biological review (Regional Road Maintenance ESA Forum 2002b).

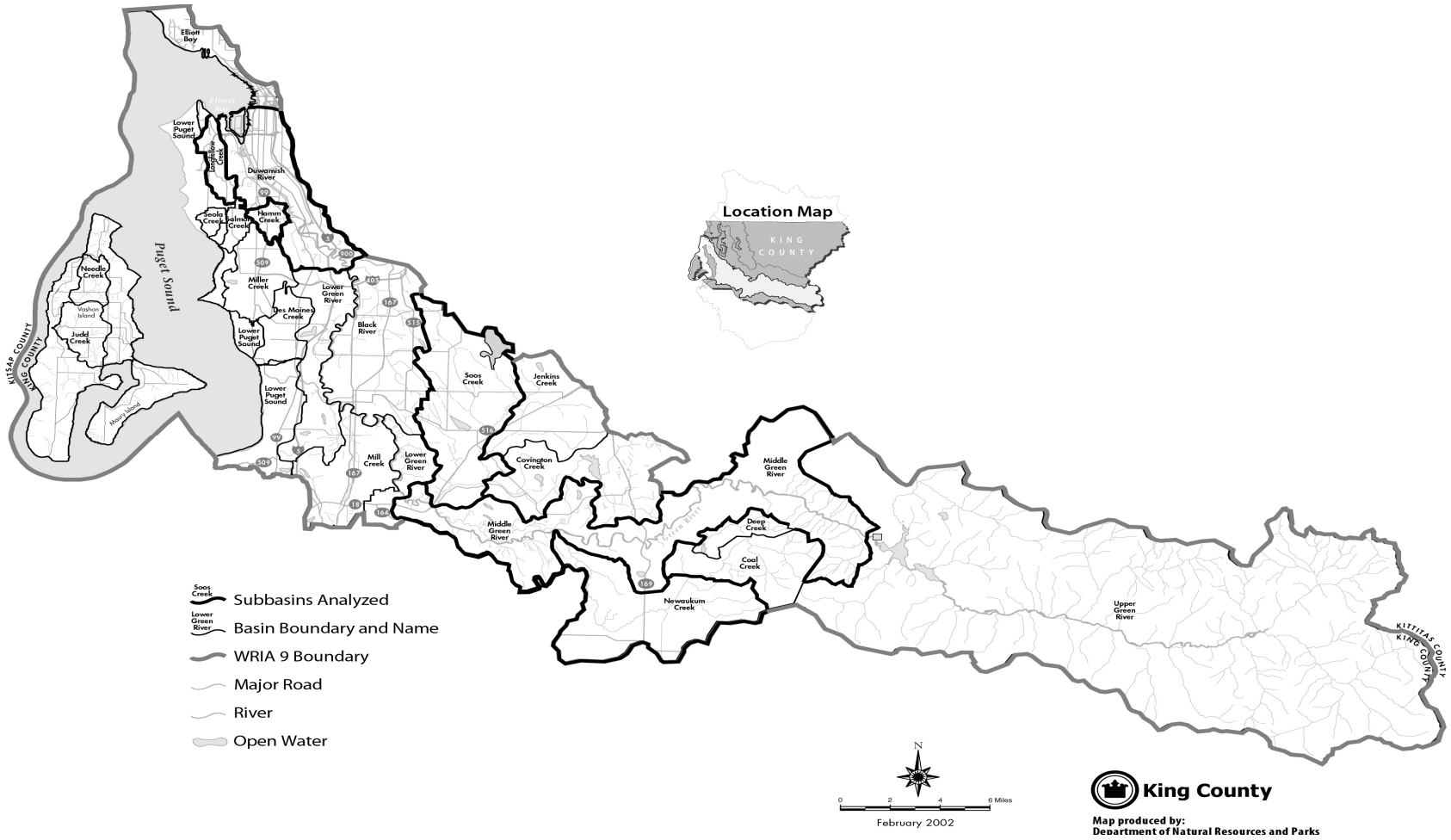

Figure 3-1. Location of Sub-Basins within WRIA 9 from the Middle Green River Sub-Basin Downstream to the Lower Duwamish River Sub-Basin.

Early action programs reviewed in Chapter 6 include the Land Management and Stormwater Management Programs. As described in Chapter 2, implementing the Land Management and Stormwater Management Programs, individually, or in combination, requires simultaneous implementation of the long-term programs: WRIA Based Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs. Therefore, in analyzing the early-action programs individually, we assumed that all long-term action programs would be fully implemented. The individual analyses of the long-term action programs evaluates them in terms of their support of the Land Management and Stormwater Management Programs.

The Land Management and Stormwater Management Programs each have the potential to directly improve, maintain, or degrade PFC indicators (by stipulating actions with physical outcomes), or to provide *indirect* effects (by stipulating actions that increase the effectiveness or certainty of the direct effects). Because this chapter evaluates the outcomes of individual programs, the analysis focuses on the direct effects of the programs.[17] In addition, the analysis in Chapter 6 evaluates the consistency of individual Model programs with the MRCI Development Limit of the NMFS 4 (d) Rule for chinook salmon (Appendix E). Determinations were made as to whether individual Model programs substantially, partially, or do not address the MRCI limit considerations, and the results of these determinations are presented in table format. Support for these determinations is further provided in narrative descriptions.

3.5 SYNERGISTIC EFFECTS OF THE MODEL PROGRAMS – CHAPTER 7

Chapter 7 discusses and evaluates the synergistic effects on each MPI indicator (as defined above in Section 3.1) of implementing all Model programs. For example, simultaneously implementing the Land Management, Stormwater Management, and Regional Road Maintenance Programs together may maintain or move baseline conditions toward PFC, whereas implementing any of the programs individually or in pairs may not.

In this chapter, we identify where synergy could potentially occur between the Land Management, Stormwater Management, and Regional Road Maintenance Programs. Chapter 7 also evaluates the consistency of the Model in meeting the MRCI Development Limit of the NMFS 4(d) Rule for chinook salmon (Appendix E) if all Model programs are applied. This MRCI evaluation does not include the Regional Road Maintenance ESA Program Guidelines, which are covered under Limit 10 of the NMFS 4(d) Rule for chinook salmon. As in Chapter 6, determinations were made regarding whether the other individual Model programs substantially, partially, or do not address the MRCI limit considerations, and the results are presented in table format. Support for these determinations is provided by narrative descriptions in the table.

3.6 ANALYSIS OF LONG-TERM PROGRAMS

Unlike the early action programs, the following long-term programs do not provide specific management actions. The long-term programs are intended to modify the early-action programs over time and provide guidance for habitat-based restoration consistent with or necessary for achieving salmonid conservation and recovery of listed species (as discussed in Section 4.1). The stormwater planning element of the Stormwater Program also acts in the long-term, essentially as a subset of the actions of the WRIA Based

[17] Again, discussion of the Regional Road Maintenance ESA Program Guidelines is not included in this chapter because it was reviewed as a stand-alone program in a separate biological review (Regional Road Maintenance ESA Forum 2002).

Planning Program). The early action programs contain planning, monitoring and adaptive management elements (such as the stormwater planning element of the Stormwater Management Program) that overlap to some extent with the long-term programs.

3.6.1 WRIA Based Planning Program

Watershed planning is intended to identify a means to protect salmon habitat as well as restore it, through mechanisms including regulation, incentives, best management practices (BMPs), acquisition, and education. The WRIA Based Program was analyzed to evaluate its function in achieving restoration of salmon and bull trout habitat. This review determined whether the appropriate planning entities and new scientific information would be incorporated into the planning process, whether program elements were sufficiently defined to likely result in planning actions that would lead to recovery, and if implementation of planning would be likely. Watershed planning was reviewed to identify links to other Model programs, particularly the Stormwater Management, Habitat Funding, and Monitoring and Adaptive Management Programs.

3.6.2 Monitoring and Adaptive Management Program

The Monitoring and Adaptive Management Program was analyzed to determine if it would be likely to reach its stated objectives, which include the following:

- Increase the knowledge of ecosystem processes and functions,
- Define roles and responsibilities of those with a responsibility or opportunity to improve habitat and recover salmonids,
- Gather relevant information of appropriate quality and use in management,
- Implement institutional changes to ensure progress toward specific, measurable recovery goals and habitat objectives, and
- Protect and improve institutional functions (management, staffing, budgets, training, etc.), as necessary, to ensure ecosystem functions and processes are protected and improved.

For the purposes of this biological review, the determination most relevant to maintenance and restoration of PFC was whether the Monitoring and Adaptive Management Program would achieve the objective of restoration and protection of ecosystem functions and processes. For the Monitoring and Adaptive Management Program to contribute to this last goal, it was assumed that each of the preceding goals would be achieved.

In addition to the long-term Monitoring and Adaptive Management Program, monitoring and adaptive management provisions are incorporated into the Land Management, Stormwater Management and Regional Road Maintenance Programs. These provisions tend to be general, but have somewhat different purposes. The Stormwater Management Program contains a variety of monitoring goals and objectives that will provide information that addresses the habitat effects of stormwater provisions as well as the effects of other Model programs. These monitoring objectives include collecting baseline information on Tri-County streams, as well as analysis of specific actions. Land Management Program Model Policy No. 9 requires jurisdiction to establish a monitoring and evaluation method to determine the effectiveness of restoration, enhancement, and recovery strategies for listed species. We assume that to be effective, monitoring and evaluation requirements must provide direction on how monitoring will be conducted, or how monitoring programs will be designed, and how results will be evaluated.

3.6.3 Habitat Acquisition and Restoration Funding Program

The Habitat Acquisition and Restoration Funding Program of the Model was evaluated following a stepwise process.

- The total funding commitment for salmonid recovery was estimated. The annual Tri-County 1% commitment of total capital budgets, as proposed in the Model, was calculated at the watershed level for jurisdictions in Tri-County WRIAs 5 (Stillaquamish), 7 (Snohomish), 8 (Cedar-Sammamish), 9 (Duwamish-Green), 10 (Puyallup-White), and 11 (Nisqually). The total funding level was then proportionally allocated by watershed, based on watershed area, to estimate the potential funds available in each watershed for salmonid restoration.
- The projected cost of restoration was determined for WRIA 9, and the resulting progress towards PFC was estimated. WRIA 9 was selected because it had the most complete information about restoration needs for the watershed and the associated costs. Project lists from reports prepared by the U.S. Army Corps of Engineers (2000), City of Seattle (2001), and WRIA 9 (2001) were assumed to constitute habitat protection and restoration needed to contribute to PFC (in lieu of a WRIA 9 Conservation Plan). The WRIA 9 share of total annual Tri-County funding was next compared with the total costs of completing these projects (both annualized and total costs) to determine what could be accomplished under the Habitat Acquisition and Restoration Funding Program over time.
- Annual funding allocation was predicted. The analysis predicted how jurisdictions would likely prioritize habitat projects in the short term (based on recent Capital Improvement Program [CIP] spending and in lieu of WRIA Conservation Plans) and by project type based on Salmon Recovery Funding Board (SRFB) data. SRFB spending is assumed to serve as a surrogate for WRIA conservation plans[18] in predicting how the jurisdictions cooperating on a watershed level would likely prioritize habitat projects.
- Mechanisms to ensure that funding would be sustained over time were evaluated.

Analysis of the Model's Habitat Acquisition and Restoration Funding Program is provided in Section 6.7.

[18] WRIA conservation plans for the Tri-County area are generally not expected to be available until 2005.

4. CONSISTENCY OF THE MODEL WITH FEDERAL GUIDANCE AND SCIENTIFIC LITERATURE

Chapter 4 discusses the reliability and appropriateness of the ecological and technical principles used as the basis for developing the Tri-County Model (4) Rule Response Proposal (Model). This chapter uses the guidance provided by the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) for conserving salmonids and other sources of best available science.

Section 4.1 evaluates how the Model relates to the NMFS *Coastal Salmon Conservation: Working Guidance for Comprehensive Salmon Restoration Initiatives on the Pacific Coast* (NMFS 1996). The ecological goals of each Model program (summarized in Section 2.2) are assessed against the five NMFS Habitat Objectives (identified in 4.1.1).

Section 4.2 explains how the Model relates to the USFWS Interim Guidance for Bull Trout. Although the USFWS has not developed a special rule for bull trout to address matters regulated by the Model, it has developed Interim Conservation Guidance for bull trout. We evaluate how the Model relates to the overall objectives of the USFWS Interim Conservation Guidance (USFWS 1998c).

Section 4.3 evaluates the programmatic and technical concepts of each program. The analysis used "best available science" as defined by WAC 365-195-905 to identify literature appropriate to evaluate the main technical concepts of each program. Where possible, the technical concepts were specifically evaluated with regard to their ecological soundness.

Chapter 4 includes the following sections:

- 4.1 Consistency with NMFS Guidance
  - 4.1.1 Consistency of Model Programs with NMFS Habitat Objectives
  - 4.1.2 Consistency of the WRIA Based Planning Program with NMFS Critical and Desirable Elements
- 4.2 Consistency with USFWS Interim Guidance
  - 4.2.1 Bull Trout Properly Functioning Conditions
  - 4.2.2 Model Consistency with Bull Trout Interim Guidance
- 4.3 Evaluation of Technical Concepts
  - 4.3.1 Land Management Program
  - 4.3.2 Stormwater Management Program
  - 4.3.3 Regional Road Maintenance ESA Program Guidelines
  - 4.3.4 WRIA Based Planning Program
  - 4.3.5 Habitat Acquisition and Restoration Funding Program
  - 4.3.6 Monitoring and Adaptive Management Program
  - 4.3.7 Summary of Evaluation of Technical Concepts

4.1 CONSISTENCY WITH NMFS GUIDANCE

NMFS developed guidance for salmon conservation planning in the *Coastal Salmon Conservation: Working Guidance for Comprehensive Salmon Restoration Initiatives on the Pacific Coast* (NMFS 1996) help Pacific Coast states, Tribes, and other entities initiate coastal salmon restoration programs. In this section, we evaluate only the goals of each Model program. The technical principles and implementation

of each program (discussed in Section 4.3 and Chapters 5 through 8) may fall short of, meet, or exceed the goals of each Model program.

The NMFS guidance (NMFS 1996) states that success in restoring coastal salmon populations will ultimately provide the following:

- Increased abundance of naturally spawned fish in evolutionarily significant units (ESUs) to self-sustaining levels, not at risk of extinction.
- Broad distribution of naturally spawned fish within each ESU.
- Genetic diversity in a pattern and at levels consistent with natural evolutionary processes, both within and among ESUs.

Section 4.1.1 evaluates the principles, habitat objectives, scientific findings, and purposes of each program (see Section 2.2) to determine whether NMFS' Habitat Objectives (NMFS 1996) are met by each program, as well as by the entire Model. The terminology and format used in the different programs to state these principles are inconsistent, making it difficult to determine whether there is a common ecological basis among programs. Therefore, we have used the terminology specific to each Model program in this chapter to avoid confusion.

Section 4.1.2 evaluates whether the Watershed Based Salmonid Conservation Planning (WRIA Based Planning) Program establishes appropriate mechanisms to address the NMFS critical and desirable elements of a comprehensive salmon restoration program (NMFS 1996).

4.1.1 Consistency of Model Programs with NMFS Habitat Objectives

NMFS guidance describes the following five habitat objectives as essential elements of a comprehensive framework to maintain (where adequate) and restore (where inadequate) ecosystem processes and functions (NMFS 1996):

Objective 1. Maintain and restore natural watershed processes (rather than a specific *state*) that create habitat characteristics favorable to salmonids. Processes include natural rates of delivery of water, sediment, heat, organic materials, nutrients, and other dissolved materials.

Objective 2. Maintain habitats required by salmonids during all life stages from embryos and alevins through adults. These habitats include migration corridors, spawning habitat, and holding and rearing habitat.

Objective 3. Maintain a well-dispersed network of high-quality refugia to serve as centers of population expansion. By preserving habitats that retain a high degree of ecological integrity, populations will have the greatest probability of surviving natural disturbance or long-term shifts in environmental conditions.

Objective 4. Maintain connectivity between high-quality habitats to allow for reinvasion and population expansion. Persistence of metapopulations depends on maintaining connectivity between sub-populations through improvement and maintenance of natural corridors.

Objective 5. Maintain genetic diversity. Maintaining genetic diversity depends on well-dispersed, properly functioning habitat.

The ecological goals and/or basic principles of each program, discussed in Sections 2.1 and 2.2, are evaluated against these objectives in the following text.

4.1.1.1 Land Management Program

The biological goals stated in the Land Management Program (summarized in Section 2.1.1) are appropriate and necessary to contribute to the conservation of listed salmonids and are essentially a restatement of portions of the NMFS coastal salmon conservation guidance objectives. While these goals are valid, they are too broad to evaluate as a basis for the Land Management Program. The habitat objectives stated in the Land Management Program are more specific, and are evaluated below:

- "Provide for appropriate access for unimpeded movement of salmonids during all life history stages within and among all appropriate habitats within their historic range and not artificially modify natural barriers to upstream areas that are not in the natural range."
- "Provide structural habitat through appropriate natural channel or wetted basin form and process."
- "Provide for habitat-forming processes crucial to maintaining and restoring aquatic and edge habitats."

The first objective addresses NMFS Habitat Objective Nos. 2 and 4 by maintaining connectivity among habitats needed for all life stages. The second and third objectives address NMFS Habitat Objective No. 1, in which maintaining natural processes is a specific goal. Collectively, the habitat objectives stated in the Land Management Program address the NMFS Habitat Objective Nos. 1, 2, and 4. The Land Management Program does not directly address Habitat Objective Nos. 3 and 5.

4.1.1.2 Stormwater Management Program

The Stormwater Management Program does not state specific ecological principles or goals, but states that it is based on the following two general scientific findings:

- "A root cause of degraded salmonid habitat is flow regimes that have been altered from the natural state by increases in effective impervious surfaces."
- "In urbanized basins, sub-basins, or watersheds, unalterably high effective impervious surface area probably precludes substantial improvement of the natural processes that defined predevelopment flow regimes."

While these scientific findings are not stated as program goals, for the purposes of evaluating them against the NMFS Habitat Objectives, we assume from the scientific findings that the objectives of the Stormwater Management Program are to minimize or mitigate the deleterious effects of impervious surfaces on salmonid habitat. Specifically, this means to maintain or improve natural hydrologic processes, which partially addresses NMFS Habitat Objective No. 1.

The Stormwater Management Program also lists goals and objectives for each of the 14 programmatic elements (see Section 2.1.2). While these goals and objectives can generally be inferred to have ecological benefits, they are not stated as biological goals and are not directly comparable to NMFS Habitat Objectives. The scientific and technical implementations of these programmatic goals are evaluated in Section 4.3.2.

The scientific findings forming the basis for the Stormwater Management Program partially address NMFS Habitat Objective No. 1.

4.1.1.3 WRIA Based Planning Program

WRIA based planning provides lists of expected conservation planning benefits, WRIA based planning framework principles, committee goals, a watershed assessment framework, and watershed assessment goals. The WRIA based planning framework principles can generally be compared to NMFS Habitat Objectives. All other items are programmatic. Where applicable, the scientific and technical foundations of these programmatic items are evaluated in Section 4.3.4. The WRIA based framework principles are discussed below:

- "Ecosystem processes critical to the sustainability of salmonids (and other aquatic species) occur at spatial scales greater than that of individual programs or jurisdictions, as well as at varying time scales."
- "The benefits of coordinated and collaborative action among jurisdictions within a watershed to protect and restore ecosystem processes and habitat are greater than that of actions taken in isolation, for both listed species and the jurisdictions."
- "Watershed based salmonid conservation plans are ecosystem-based and multi-species in scope."
- "The plans would provide consistent information across watersheds that would allow for cross-WRIA comparisons and priority setting. Cross-WRIA consistency is essential for individual plans to inform and integrate with ESU-level restoration planning efforts by the Services and state co-mangers."

The first principle above addresses NMFS Habitat Objective No. 1 by focusing on ecosystem processes. The second and fourth principles are not directly comparable to the NMFS Habitat Objectives. The third principle addresses inter-species genetic diversity, but does not address intra-species diversity, which is the intent of NMFS Habitat Objective No. 5. Collectively, the planning framework principles discussed above address the NMFS Habitat Objective No. 1.

4.1.1.4 Monitoring and Adaptive Management Program

The following principles form the foundation of the Monitoring and Adaptive Management Program:

- "Precautionary Principle: In the absence of certainty, an environmentally protective approach should be taken."
- "Ecosystem Understanding: Management decisions should be consistent with the current understanding of ecosystem processes and functions."
- "Flexibility: Management systems should be dynamic and flexible enough to respond effectively to changes in the natural systems."
- "Stakeholder Investment: The Model should gain essential stakeholder participation, agreement, and commitment, and stakeholders should make a long-term commitment to the process, recognizing that salmonid recovery is a long-term undertaking."

These principles are stated as management principles, but include language that generally links them to ecological goals. The Model's general ecological goals (protection of habitat, recognition of processes and functions, and natural dynamics) are generally consistent with, but do not directly correlate to the NMFS Habitat Objectives.

4.1.1.5 Habitat Acquisition and Restoration Funding Program

The Habitat Acquisition and Restoration Funding Program lists the following purposes:

- "To offset residual impacts to chinook salmon and bull trout habitat associated with day-to-day land use activities."
- "To undertake a sustained program to preserve and restore important salmonid habitat."

These statements are generally consistent with NMFS Habitat Objectives, but do not state enough detail to compare them against individual NMFS Habitat Objectives.

4.1.1.6 Overall Model Consistency with NMFS Habitat Objectives

The objectives, principles, purposes, and scientific findings of individual Model programs combine to collectively address NMFS Habitat Objective Nos. 1 (natural watershed processes), 2 (habitat for all life stages), and 4 (connectivity). The stated objectives and principles of the Model programs do not directly address NMFS Habitat Objective Nos. 3 (high quality habitat network) and 5 (genetic diversity). However, the objectives and principles of individual Model programs do not conflict with any of the NMFS Habitat Objectives. In most cases, program objectives and principles are not stated as a biological or habitat goal that can be directly compared to the NMFS Habitat Objectives.

4.1.2 Consistency of the WRIA Based Planning Program with NMFS Critical and Desirable Elements

According to NMFS guidance, a comprehensive salmon restoration plan must substantively include the following critical and desirable elements:

1. Identify at appropriate scales the factors that have contributed to decline of the ESUs.
2. Establish priorities for action.
3. Establish explicit objectives and timelines for eliminating or reducing all major factors for decline and for achieving desired population characteristics.
4. Establish quantifiable criteria and standards by which progress toward each objective will be measured.
5. Adopt measures (actions) needed to achieve the explicit objectives. A plan should include measures to protect and restore habitat wherever habitat condition is a factor of decline, whether on private or public land.
6. Provide high levels of certainty that the identified measures and actions will be reliably implemented, including necessary authorities, commitments, funding, staffing, and enforcement measures.
7. Establish a comprehensive monitoring program, including methods to measure whether objectives are being met and to detect population declines and increases in each ESU.
8. As much as possible, integrate federal, state, Tribal, local, corporate, and other non-governmental activities and projects that are designed to restore salmon populations and the habitats upon which they depend.
9. Utilize an adaptive management approach that actively shapes management actions to generate needed information.

As noted above, these critical and desirable elements apply to a comprehensive salmon restoration plan. Although the Model is not a comprehensive salmon restoration plan, these critical and desirable elements would be appropriate for assessing the WRIA Based Planning Program.

The WRIA Based Planning Program can be evaluated to determine whether it establishes appropriate mechanisms to address the NMFS critical and desirable elements. The correlation between the WRIA

Based Planning Program elements and NMFS critical and desirable elements is summarized in Table 4-1. As shown in Table 4-1, every NMFS critical and desirable element is addressed by one or more of the WRIA Based Planning Program element requirements. The specific requirements of the WRIA Based Planning elements will determine whether each critical and desirable element is adequately addressed. This analysis only determines whether the NMFS critical and desirable elements are included in the program requirements and does not evaluate the content of each WRIA Based Planning element. Specific requirements of the WRIA Based Planning Program are evaluated in Section 6.5.

Table 4-1. NMFS Critical and Desirable Elements Addressed by WRIA Based Planning Elements

	WRIA Based Planning Elements									
NMFS Critical and Desirable Elements	**Watershed Coordination**	**Certainty of Planning, Funding, and Implementation**	**Science-Based Watershed Assessment**	**Watershed Based Goals**	**Action Alternatives**	**Watershed Plans**	**Plan Approval and Adoption**	**Public Outreach and Involvement**	**Monitoring**	**Adaptive Management**
Appropriate Scales	X	--	X	X	--	--	--	--	--	--
Priorities	X	X	--	X	X	X	--	--	--	--
Explicit Objectives & Timelines	--	X	--	X	--	X	X	--	X	--
Quantifiable Criteria & Standards	--	X	X	X	--	X	--	--	X	--
Actions	--	X	--	--	X	X	--	--	--	--
Certainty	--	X	--	--	--	X	X	--	X	X
Monitoring	--	X	X	--	--	X	--	--	X	X
Integrate Other Activities & Projects	X	--	--	X	--	X	--	X	--	X
Adaptive Management	--	X	X	--	--	X	--	--	--	X

X - Addressed

-- - Not Addressed

4.2 CONSISTENCY WITH USFWS INTERIM GUIDANCE

The USFWS has not yet formulated a special rule for bull trout pursuant to Section 4(d) of the Endangered Species Act (ESA) regarding activities regulated by the Model. The USFWS has formulated a special rule for bull trout that exempts certain educational and scientific activities from the take prohibition, as well as exempts fishing activities that are authorized under State, National Park Service, or Native American Tribal laws and regulations (64 F.R. 210:58910-58933). However the USFWS has issued a notice of intent to issue a special rule regarding habitat restoration and other land and water management activities for bull trout (64 F.R. 210:58934-58936). Thus, we have used information in the USFWS Interim Conservation Guidance (USFWS 1998c), as well as other publications, to evaluate the potential effects of the Model on bull trout habitat.

The interim conservation guidance is a tool for conducting ESA activities (e.g., consultations, take permits) and providing general guidance for bull trout conservation efforts. The interim bull trout guidance is organized by habitat and management issues that address its overall objectives. Habitat issues include temperature, habitat complexity, habitat connectivity, and substrate composition/stability. Land management issues include riparian/floodplain protection and roads. The guidance incorporates available information on bull trout life history needs, and it is intended to be compatible with the primary components of a formally adopted restoration plan. There are two overall objectives of the guidance:

- To preserve or restore connectivity among bull trout sub-populations and their habitats through habitat restoration or protection, and
- To restore and maintain natural ecosystem processes to improve or protect habitat, thereby expanding abundance, distribution, and life history forms (i.e., fluvial, adfluvial, resident, anadromous).

These objectives are equivalent to NMFS Habitat Objective Nos. 4 (connectivity) and 1 (natural watershed processes), respectively. As discussed in Section 4.1.1.6, the objectives, principles, purposes, and scientific findings of the individual Model programs combine to collectively address NMFS Habitat Objective Nos. 1 and 4. No additional analysis was conducted on these USFWS Interim Guidance Objectives.

The following subsections provide the relevant information contained in these NMFS and USFWS documents that is pertinent to evaluation of the Model. This level of detail is provided for bull trout because only interim guidance is currently available from USFWS.

4.2.1 Bull Trout Properly Functioning Conditions

Properly functioning conditions for bull trout habitat are considered separately from chinook salmon because bull trout have more restrictive requirements, particularly for temperature (Berge and Mavros 2001). Bull trout spawning and rearing habitat is distributed differently across the Tri-County area from chinook salmon habitat. The two species require some similar habitat conditions, but also require different, species-specific habitat conditions. The designation of critical habitat for listed species is required under Section 4(a)(3)(A) of the ESA and is generally determined at the time of listing. However, the critical habitat designation for bull trout was deemed “not determinable” by USFWS (1998) due to a limited understanding of the habitat requirements of this species. In the Puget Sound analysis area, there are 15 delineated sub-populations of bull trout from 8 river basins. The most abundant sub-populations occur in north Puget Sound streams. Four life-history forms are recognized for bull trout, resident, adfluvial, fluvial, and anadromous fish, and each of these life-history forms may be present within the Tri-County area. Information used to assess bull trout habitat is presented in Section 4.2.1 of this analysis. Currently, USFWS is determining critical habitat for the five distinct population segments (DPSs) of bull trout and is scheduled to have a proposed designation for the Coastal-Puget Sound distinct population segment in September 2003.

4.2.1.1 Spawning/Early Rearing Habitat

Identified and potential bull trout spawning and early rearing habitat occurs in the upstream portions of several Tri-County watersheds. The Stillaguamish, Snohomish, and Cedar Rivers have identified reproducing populations of bull trout (Mongillo 1993, Washington Department of Fish and Wildlife 1998). The south fork of the Stillaguamish River has bull trout spawning and early rearing habitat in the highest reaches of the north and south forks, and in Deer Creek, Boulder River, and Canyon Creek. In the Snohomish River system, bull trout have been spawning and undergoing early rearing in the North Fork Skykomish River, and upstream from the Sunset Falls fishway in the South Fork Skykomish, since the

mid-1950s. The Stillaguamish and Skykomish populations include both fluvial and anadromous forms of bull trout. There is also at least one resident population of bull trout in Troublesome Creek, a tributary of the upper North Fork Skykomish River. In the Cedar River, an adfluvial population of bull trout exists in Chester Morse reservoir, with spawning and early rearing habitat in the upper Cedar and Rex Rivers. Individual bull trout from the Chester Morse population most likely pass downstream from Masonry Dam, but are then isolated from the reproducing population by upstream migration barriers. Isolated bull trout are likely to survive and rear to an advanced age in the lower portions of the watershed, without the opportunity to reach reproductive habitat.

Individual sub-adult and adult bull trout have also been identified at other locations in various streams and along Puget Sound shorelines within the Tri-County area. The origins of these individuals have not been identified, nor have other spawning populations been identified in available information. Bull trout that occur in the lower reaches of streams and estuaries without identified spawning populations (such as the lower Duwamish River) likely originate from Puget Sound streams that have substantial bull trout populations.

Rieman and McIntyre (1993) and Baxter and McPhail (1996) summarize available information on the habitat requirements of bull trout. "The evidence is mostly correlative, however, leaving critical thresholds poorly defined" (Rieman and McIntyre 1993). Bull trout have very cold water spawning and rearing habitat requirements and occur at the highest densities in streams having maximum summer temperatures below 14°C. They have been found at lower densities in streams having maximum summer temperatures of 12 to 18°C. Spawning generally takes place in cold headwater streams with temperatures of 9°C or lower, and early rearing takes place in these same cold waters.

Bull trout commonly inhabit shallow depths in streams (Baxter and McPhail 1996). Fry and young juveniles most commonly occupy depths less than 1 m, frequently less than 0.4 m. They appear to favor these shallow depths where there is good stream cover (water velocity break, woody debris, substrate, and undercut streambanks), particularly during daylight hours. Spawning and early rearing habitat used by bull trout commonly has low levels of fine substrate (sediment < 6.35 mm). Redds have been commonly found at depths below 0.4 m, but rarely deeper than 0.9 m. Water velocities occupied by fry and young juveniles are generally not greater than 0.3 to 0.4 m/sec nose velocity, or less than 0.8 m/sec mean column velocity.

4.2.1.2 Migratory/Foraging Corridors

Adults and sub-adults of anadromous life forms of bull trout use the larger portions of river systems as migratory and foraging corridors between early rearing areas and Puget Sound shorelines. Downstream migrations generally occur during spring and early summer. Upstream migrations generally occur during autumn; however, spawning adults may begin return migrations as early as June. The duration of these migrations is not documented in available literature. Migratory corridors used by anadromous bull trout have higher maximum summer temperatures, but migration commonly occurs during spring and autumn, when stream temperatures are substantially lower than summer maximums. Temperature criteria for the migratory corridors of anadromous bull trout are not clearly defined by available literature. Migrating bull trout appear to typically prefer water temperatures ranging between 10 to12°C (McPhail and Murray 1979; Buchanan and Gregory 1997). However, adult anadromous bull trout may be capable of tolerating higher temperatures.. Kraemer (1994) found migrating and staging char in Puget Sound tributaries, such as the Stillaguamish River, with temperatures at or above 20°C. Adult and sub-adult bull trout may use cool water refuge habitat during their downstream and upstream migrations. Other migratory habitat requirements have not been defined for bull trout. However, deep pool habitat is often recognized as important for sub-adult and adult bull trout in migratory, foraging, and over wintering areas in tributary

streams. This analysis of the Model assumes that bull trout have requirements similar to larger juvenile chinook and other salmon for migratory corridor habitat.

4.2.1.3 Puget Sound Shorelines

Most information on bull trout use of Puget Sound shorelines has been collected in Skagit Bay and Port Susan at the mouth of the Stillaguamish River (Kraemer 1994). This information indicates that anadromous juveniles enter the nearshore environment from April through June, where they spend most of the summer feeding. Preliminary feeding studies suggest that the marine distribution of bull trout overlaps the distribution of surf smelt and Pacific herring, particularly at the spawning beaches of these forage fish (Kraemer 1994). Because bull trout in Puget Sound appear to feed extensively on fish, including juvenile salmonids (Kraemer 1994), nearshore marine areas represents an important component in the life cycle of anadromous individuals. Bull trout presence may overlap largely with distributions of chinook and other salmon smolts in nearshore marine areas, particularly in early spring.

Information on the extent and distribution of migrating char is scarce. Sub-adult char return to the rivers at 250 to 350 mm in length. After over-wintering in fresh water, some re-enter marine waters in late February. Most anadromous char appear to reach maturity after their second migration to marine waters. Many of these fish return to freshwater from late May through early July to begin their spawning migration to upstream areas (Kraemer 1994). Sub-adult bull trout may return to freshwater streams from late summer through early autumn. Anadromous char from the Skagit River have been found in Puget Sound as far as 40 km (25 miles) from the mouth of the river on the east side of Camano Island (Kraemer 1994).

Temperatures of Puget Sound shorelines vary widely from the shallow water of protected bays to deeper portions of exposed shorelines during the periods occupied by bull trout. No temperature requirements for bull trout have been indicated by available information for Puget Sound shorelines.

4.2.2 Model Consistency With Bull Trout Interim Guidance

Implementing the Model will tend to maintain existing conditions that support the current distribution of bull trout within the Tri-County area. Generally, the Model will apply in areas that provide migratory and foraging corridors for bull trout. In these areas, water temperature is important during the spring and autumn, when bull trout migrate through the corridors. Available information indicates that temperatures during bull trout migration ideally should not exceed 15ºC. Existing mid-summer water temperatures higher than 15ºC are common, but are less likely to influence bull trout populations than spring and autumn temperatures along migratory corridors. The Model is not likely to substantially alter water temperature conditions along potential bull trout migratory corridors. Specific analysis of the Model's adequacy in addressing bull trout habitat requirements is included in Section 4.3 and Chapters 5 through 8.

4.3 EVALUATION OF TECHNICAL CONCEPTS

This section addresses the technical and programmatic concepts supporting each of the main elements of the Land Management, Stormwater Management, WRIA Based Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs. These concepts are discussed as they relate to salmon and bull trout habitat.

Our assessment of the technical concepts upon which the Model is based relies on information available in published literature dealing with the appropriate issues. We have used the “best available science” as

defined by WAC 365-195-905 to identify literature appropriate to support the technical concepts. This definition of best available science includes the following criteria.

- **Peer Review:** publications that have been critically reviewed by qualified experts in the appropriate disciplines.
- **Methods:** methods used to conduct the investigation that can be replicated and that follow standard methods of the scientific discipline.
- **Conclusions and Inferences:** logical conclusions and inferences are presented and based on reasonable assumptions consistent with underlying general theory.
- **Quantitative Analysis:** analysis of data use appropriate statistical or quantitative methods.
- **Context:** assumptions, data, analytical techniques, and conclusions are appropriately framed within the prevailing body of pertinent scientific knowledge.
- **References:** assumptions, techniques, and conclusions are referenced with citations to appropriate existing literature or information sources.

Our analysis found that literature dealing with the various disciplines included in the Model programs generally supports the technical concepts upon which the programs are based. Most of the literature meets the criteria for best available science. Much of this available literature obviously has not received peer review; however, one or more peer reviewed publications generally support the same information as presented in those publications for which peer review is not obvious. Some of the technical concepts, such as the width of appropriate riparian zones, are still the subject of active research that may revise the concepts in the near future. The science of salmonid habitat evaluation and restoration is still in its infancy with much yet to be learned. As recently described by Roni et al. (2002), existing research and monitoring of stream habitat restoration techniques is not adequate. Thus, the "best available science" will most likely be substantially improved in the near future, in part through the monitoring requirements of the Model.

We find the Model to be primarily based on best available science as supported by available literature, except where we specifically note otherwise throughout this biological review. This does not mean that the Model addresses all the technical aspects of habitat characteristics that may be supported by one or more of the papers available in the scientific literature. It is not obvious from the available Model documentation what levels of peer review the Model received during its formulation.The specific information and literature used by the formulators of the Model is commonly not referenced within the Model. An exception is a report on the scientific basis for the Model management zone (MZ) regulations (Appendix A of the Model) that was developed by the Tri-County Management Zone Technical Committee relying on referenced literature. Also available to the formulators to support Model development was the Tri-County Urban Issues ESA Study (R2 Resource Consultants 2000b), and the Urban Issues Document Database. The database, together with the review of literature by Brown and Flake (1999), provided the Model formulators with extensive reviews of pertinent reports that include the best available science obtainable at that time on the appropriate subjects. Therefore, we assumed that the formulators relied on best available science in general terms, but did not specifically review all available literature that represents best available science. We have found the Model is supported by information from a body of literature that represents best available science.

An annotated bibliography and a compendium of review commentaries of this biological review are to be appended to this review.

4.3.1 Land Management Program

The primary ecological concepts as they apply to specific Land Management Program elements are evaluated in this subsection. The following Land Management Program elements are included in the evaluation:

- Considerations for Riparian Buffers
- Fixed Regulations Option
- Management Zone (MZ) Standards
- Inner MZ Width Averaging
- Inner MZ Restrictions-Exceptions
- Outer MZ Regulations
- Wetland Buffers
- Retention of Vegetation within the MZ
- Allowed Uses Inside the MZ
- Site-Specific Habitat Evaluation Option
- Habitat Evaluation Overview
- Programmatic Habitat Evaluation Option
- Mitigation Requirements and Guidelines.

The Land Management Program is designed to be compatible with Washington State planning and enabling legislation under both the Growth Management Act (GMA) and authority given to counties and cities that do not plan under GMA. The Land Management Program includes model planning policies to meet GMA requirements that are to guide development regulations consistent comprehensive plan requirements (RCW 36.70A.040). These planning policies only provide general guidelines. Local jurisdictions have great latitude in framing policy language, which would be consistent with the development regulations of the Growth Management Act. The GMA requires local cities to plan for and develop regulations for critical areas (RCW 36.70A.050, 060, 170.). Critical areas include "Fish and wildlife habitat conservation areas," which specifically include areas with which endangered, threatened, and sensitive species have a primary association (WAC 365-190-080[5]). Counties and cities must include the "best available science" when developing policies and development regulations to protect the functions and values of critical areas and must give "special consideration" to conservation or protection measures necessary to preserve or enhance anadromous fisheries (RCW 36.70A.172(1); WAC 365-195-900 through 925). Counties and cities not required to plan under the GMA have authority for planning under RCW 36.70 and 35.63 and 35a.63. General authority and responsibility for planning to address anadromous fish habitat for non-GMA jurisdictions are contained in the Washington State Environmental Policy Act (SEPA) RCW 43.21C) and the Shoreline Management Act (SMA) (RCW 90.58).

4.3.1.1 Considerations for Riparian Buffers

Variation in Reported Buffer Width Functions: A wide range of recommended buffer widths is common among studies. However, none of the reported studies recommend zero width, nor do the studies recommend the equivalent of more than several site potential tree heights. Pollack and Kennard (1998) recommended interim buffer widths of 250 ft on all perennial streams. Buffer widths of one site potential tree height (SPTH; 50 to 250 ft based on a 300 year SPTH in western Washington) would be

required to reasonably provide for a full range of riparian functions, and therefore, not contribute significantly to the loss of salmonid habitat. May (2000) and other extensive reviews provide detailed summaries of buffer width sizes necessary to achieve stream and riparian functions (Knutson and Naef 1997, FEMAT 1993). The conclusions of those reviews are presented in Tables 4-2 to 4-4. However, riparian buffers are only one component of an effective management approach. Aggressive stormwater management must also be employed to maintain stream functions (May et al. 1997); conclusions regarding stormwater management are discussed in Section 4.3.2 and Chapters 5 through 8.

Table 4-2. Riparian Buffer Functions and Appropriate Widths Identified by May (2000).

Function	Range Of Effective Buffer Widths	Minimum Recommended	Notes On Function
Sediment removal and erosion control	8 – 183 m (26 - 600 ft)	30 m (98 ft)	For 80% sediment removal
Pollutant Removal	4 - 262 m (13 - 860 ft)	30 m (98 ft)	For 80% nutrient removal
Large Woody Debris	10 –100 m (33-328 ft)	80 m (262 ft)	1 SPTH based on long-term natural levels
Water Temperature	11 – 43 m (36 - 141 ft)	30 m (98 ft)	Based on adequate shade
Wildlife Habitat	10 – 200 m (33 - 656 ft)	100 m (328 ft)	Coverage not inclusive
Microclimate	45 – 200 m (148 – 656 ft)	100 m (328 ft)	Optimum long-term support

Table 4-3. Riparian Functions and Appropriate Widths Identified by Knutson and Naef (1997)

Function	Range Of Effective Buffer Widths (Ft)
Water Temperature	35 - 151
Pollutant Removal	13 - 600
Large Woody Debris	100 - 200
Erosion Control	100 - 125
Wildlife Habitat	25 - 984
Sediment filtration	26 - 300
Microclimate	200 - 525

Table 4-4. Riparian Functions and Appropriate Widths Identified from FEMAT (1993).

Function	Number of SPTH	Equivalent (Ft) Based on SPTH of 200 Ft.
Shade	0.75	150
Microclimate	up to 3	up to 600
Large Woody Debris	1.0	200
Organic Litter	0.5	100
Sediment Control	1.0	200
Streambank Stabilization	0.5	100
Wildlife Habitat	-----	30 – 183 m (98 – 600 ft)

Microclimate Control: Riparian buffer widths necessary for microclimate control are generally much wider than those necessary for other functions, with the exception of wildlife habitat. Microclimate, the local climate (humidity, wind, and air temperature) within the stream-riparian ecosystem, is primarily affected by the quality and extent of riparian vegetation. A riparian buffer width of 200 ft may provide minimum or partial microclimate function in some circumstances, however, widths greater than 328 ft are generally required to provide full microclimate protection (Spence et al. 1996; Chen et al. 1990; Brosofke et al. 1997; Franklin and Forman 1987). Watershed scale microclimate influences stream temperatures, contributing to lower temperatures in forested watersheds than in urbanized watersheds.

Large Woody Debris: Currently, large woody debris and the wood jams they produce are greatly diminished in Puget Lowland streams (Collins et al. 2002). Adequate large woody debris recruitment is generally provided with a high degree of certainty by riparian buffer widths of 100 to 200 ft (about 1 SPTH), depending on the site and stream size (Murphy and Koske 1989; Robison and Beschta 1990; McDade et al. 1990, Thomas et al. 1993). Riparian vegetation exerts a greater influence on small streams, however, and the role of large woody debris varies relative to stream size (Knutson and Naef 1997). Large woody debris is not easily transported in small streams and thus individual pieces can greatly influence channel morphology, instream cover, food resources, and sediment transport. As stream size increases, the influence of riparian vegetation and individual large woody debris decreases, while the role of logjams (affected by a river's supply and type of large woody debris) increases.

The role of large woody debris in mainstem river reaches and estuaries is less well defined. In these areas, large woody debris contributes to habitat complexity along the shorelines. Most riparian studies have not been long term, and larger buffer widths may be required for long-term recruitment or differing site conditions (FEMAT 1993; May 2000). Large woody debris can also be imported by human intervention in the short or the long term, but the effects of such artificial recruitment only provides limited short-term, direct benefits to stream habitat (e.g., fish cover, localized hydraulic complexity). Importing large woody debris would not be an adequate substitute for the multitude of long-term benefits provided by sufficiently sized buffers that would provide for long-term natural large woody debris recruitment.

Sediment Filtering: Widths of 100 to 300 ft appear to be sufficient for filtering substantial proportions of sediment (50 to 90%) originating from hill slopes (Moring et al. 1985; Karr and Schlosser 1977; Johnson and Ryba 1992; Belt et al. 1992; Lowrance et al. 1986; Lowrance et al. 1988). However, sufficiency of buffer widths is dependent on slope steepness, with wider buffers required for steeper slopes (Vanderholm and Dickey 1978). Most studies are short term, although some long-term studies have been conducted that support a buffer width of 100 to 300 ft for filtering sediment (Lowrance et al. 1986; Lowrance et al. 1988).

Streambank Stabilization: Erosion control by streambank stabilization is provided by 100- to 125-ft buffers as measured from the stream edge. This applies even in areas of high mass wasting (Raleigh et al. 1986; Cederholm 1994).

Wildlife Habitat: Habitat functions for riparian dependent wildlife require potentially large riparian buffer widths, but vary depending on the type of wildlife. Those reported in the literature range from 100 ft for macroinvertebrates (Erman et al. 1977) to more than 850 ft for nesting great blue herons (Short and Cooper 1985). Most studies report a range of 200 to 300 ft (Keller et al. 1993; Hodges and Krementz 1996) as likely to provide adequate habitat for most species. Diverse bird assemblages and selected mammals may require larger buffers of 400 to 600 ft (Jones et al. 1988; Sedgewick and Knopf 1986; Freel 1991; Melquist et al. 1981). The function of riparian areas as wildlife habitat can have direct or indirect effects on salmonid conservation, but ecosystem processes are complex and the linkages between wildlife and salmonids are poorly understood (Willson et al. 1998).

Removal of Pollutants: Buffer widths reported for removal of pollutants can vary widely based on vegetation type, soil type, and slope. Knutson and Naef (1997) report that buffer widths ranging from 13 ft to more than 850 ft are adequate for nutrient reduction or removal. However, widths of 100 ft are generally sufficient for removing nutrient or bacterial pollution (Lynch et al. 1985; Terrell and Perfetti 1989). Terrell and Perfetti (1989) also report riparian widths of 200 and 600 ft as necessary for removing pesticides and animal waste and nutrients from croplands.

Fixed- and Variable-Width Buffers: Buffers can be fixed or variable in width. May (2000) stated that fixed-width buffers are generally a political compromise between minimizing impacts to streams and minimizing impacts to developers and property owners. Fixed-width buffers do, however, risk failure unless conservatively designed. Salmonid conservation requires variable, ecologically-based approaches for establishing buffer widths at watershed, stream, or site scales. While variable-width buffers may be more ecologically sound and allow landowners more flexibility. Information does not currently exist that provides variable width buffer recommendations, and it is unlikely that such regulations could easily be implemented (Knutson and Naef 1997). With the current knowledge of riparian systems, it is difficult to determine the exact causes of habitat function degradation because it is dependent on numerous factors other than riparian vegetation. Minimal widths do not offer adequate protection, but maximum widths are not practical because of the feasibility of imposing high habitat conservation standards on development in riparian buffers (Knutson and Naef 1997). The Model MZs would often function as variable-width buffers because the MZs would be measured to include channel migration zones (CMZs), steep slopes, wetlands, and critical areas.

Design of riparian buffers must consider the ecological, cultural, and economic values of the resource, land use characteristics, and existing riparian quality throughout watersheds in order to address the cumulative impacts on stream functions and the resources being protected (Johnson and Ryba 1992; Castelle et al. 1994; Wenger 1999). Appropriate buffer sizes will depend on the area necessary to maintain the desired riparian functions for the given suite of land use activities. A wider buffer may be desired to protect streams from impacts resulting from activities such as unpermitted ad hoc trail construction, recreation, pets, garbage, and tree removal for unpermitted view improvements and hazard reduction. These concerns are associated more with areas of high-intensity land use and thus wider buffers, or restrictions that keep the potential hazard from occurring (such as building setbacks), may be needed, while narrower buffers may suffice in areas of low-intensity land use (May 2000). In addition, buffer vegetation type, diversity, condition, and maturity are equally as important as buffer width, and the best approach to providing high-quality buffers is to strive for establishing and maintaining mature native vegetation communities (May 2000).

Historically, natural riparian corridors in the Pacific Northwest were nearly continuous and the importance of riparian continuity is recognized (May et al. 1997; Naiman and Bilby 1998; Wenger 1999). Because the influence of riparian vegetation on some stream habitat functions increases as stream size decreases (e.g., control of water temperatures by shading), riparian corridor continuity is particularly important in headwater streams that make up most of the stream length within a watershed and contain more wetland areas. Therefore, protection of riparian zones in headwater areas may offer the greatest benefits to streams (Osborne and Kovavic 1993; Hubbard and Lowrance 1994; May et al. 1997). This is consistent with the Model's strategy of providing greater protection to rural areas where the greatest and most cost-effective habitat improvement opportunities are presumed to exist. Most lowland Pacific Northwest streams have fragmented riparian corridors because they flow through urbanized or agricultural areas.

The following evaluation is based on the summary presented above and is separated into water type and application. The ability of the Model MZ regulations to protect riparian vegetation is discussed in Chapter 5 and Appendix M.

4.3.1.2 Fixed Regulations Option

Management Zone Standards

The premise of the Model MZ standards is that a less restrictive standard within the urban growth area (UGA; the urban standard) in conjunction with higher standards outside the UGA (the rural standard) would be sufficient to maintain salmonid habitat functions and values and would not preclude future habitat improvement opportunities. Section 5.4 and Appendix K discuss the number and percentage of stream miles (relative to known habitat conditions) in the Tri-County area that would be affected by each MZ standard. The proposed rural and urban MZ standards are presented in Table 4-5.

Widths of the prescribed management zones are provided in Table 4-5.

Table 4-5. Widths of Prescribed Management Zones under the Model

Water Type[a]	Total Management Zone[b]	Rural Standards (ft)		Urban Standards (ft)	
		IMZ[b]	OMZ[c]	IMZ[b]	OMZ[c]
S	200	150	50	115	85
F	200	150	50	115	85
F - steep ravine delivered directly to marine shorelines	200	Greater of 100 ft or 25 ft from top of bank		Greater of 100 ft or 25 ft from top of bank	
N within ¼ mile of type S or F water	115	115	0	115	0
N greater than ¼ mile of type S or F water	65	65	0	65	0

[a] Water Type definitions:

Water Type S: all waters within their ordinary high water marks inventoried as "shorelines of the state" under chapter 90.58 RCW.

Water Type F: all segments of natural waters other than type S waters within the bank full widths of defined channels or within lakes, ponds, or impoundments having a surface area of 0.5 acre or greater at seasonal low water that contain fish habitat.

Water Type F (steep ravine): Type F streams with direct discharge to a marine shoreline and having gradient greater than 20% and annual mean flow less than 5 ft^3/s through ravine with bank slope greater than 28°.

Water Type N (within 1/4 mile upstream of type S or F water): All segments of natural waters within the bank full widths of defined channels that are not type S or F water that are perennial or seasonal streams, are physically connected by an above-ground channel system and deliver water or sediment to a type S or F water body.

[b] Measured from bank full channel edge (BCE) or edge of channel migration zone (CMZ) if present and including an additional 100 ft buffer around any identified wetland except for type N streams greater than ¼ mile of type S or F water where the wetland buffer will be 65 ft.

[c] Measured from outer edge of inner management zone (IMZ) and including an additional 100 ft. buffer around any identified wetland except for type N streams greater than ¼ mile of type S or F water where the wetland buffer will be 65 ft.

Defining the Management Zone: The value of a riparian buffer to protect aquatic habitat and provide for critical stream processes is widely accepted. The Tri-County MZ regulations require that prescribed MZs are measured from either the bank full channel edge (BCE) or measured landward from the edge of the CMZ, including associated wetlands and steep slopes where present. The CMZ is part of the inner management zone (IMZ) and subject to IMZ regulations. Therefore, where a CMZ occurs, the IMZ consists of the CMZ and the additional IMZ width standard, which varies depending on whether the UGA or non-UGA standard is applicable. The CMZ allows for natural channel migration processes to occur and promotes floodplain connectivity, which is integral to the formation and maintenance of stream habitat (May 2000). Expansion of the IMZ to include the CMZ, associated wetlands, and steep slopes, serves to provide additional buffer width where CMZs are present and, more importantly, to protect a

variety of riparian functions such as water, sediment, and nutrient supply. The CMZ definition in the Model is consistent with that presented in an extensive literature review (May 2000) of the best available science on the protection of stream-riparian ecosystems and with CMZ guidelines developed by the Washington Department of Natural Resources (WA DNR 1999).

Water Types S and F: Rural Standard: The rural standard for Water Types S and F is a 150-ft IMZ and a 50-ft outer management zone (OMZ). This provides a minimum IMZ width of 150 ft, unless a CMZ, associated wetland, or steep slope are present, in which case the IMZ would be greater, depending on the extent of these features.

Based on the recommendations presented in Tables 4-1 through 4-3, an IMZ[19] width of 150 ft would likely provide adequate protection for shade, organic litter, sediment control, and streambank stabilization. The rural MZ standard would not be adequate for minimal microclimate and wildlife habitat protection. An MZ width considerably greater than 200 ft is necessary for complete microclimate functions. Large woody debris function would not be adequate in all cases, but would likely be adequate on some streams, particularly smaller streams that are influenced more by riparian conditions and large woody debris recruitment than larger streams. Initial recommendations of the MZ technical committee called for a 300-ft (2 SPTHs) minimum buffer consisting of a 150-ft IMZ and 150-ft OMZ, plus associated CMZs, wetlands, and steep slopes to protect the broader functions such as microclimate, windthrow, and nutrient supply. For rural areas, the OMZ was reduced from 150 to 50 ft when the rural stormwater standard of 65% forest retention was adopted on a site-by-site basis. This was done based on the assumption that additional benefits (e.g., improved microclimate) would be as or more effectively protected by the 65% forest retention standard implemented across the landscape than by a greater OMZ. Nonetheless, it is recognized that such functions would not be fully protected or preserved, even with the 65% forest retention standard. Even though the 65% vegetation standard is applied to development sites, there is no guarantee that 65% vegetation retention will be achieved at larger scales (given existing knowledge of baseline conditions). Further analysis of MZ regulations, as applied to stream reaches within selected WRIA 9 sub-basins, is found in Chapter 5.

Water Types S and F: Urban Standard: The Tri-County urban standard for Water Types S and F is a 115-ft IMZ and an 85-ft OMZ. This provides a minimum MZ width of 200 ft, unless a CMZ, associated wetland, or steep slope is present, in which case the IMZ would be greater, depending on the extent of these features. An IMZ width of 115 ft will not provide protection for microclimate, nor will it provide full protection for large woody debris recruitment and sediment filtering. The OMZ would likely provide some additional riparian function by retaining additional vegetation that is spatially connected to the IMZ, but only 65% of the vegetation needs to be retained in the entire MZ. If the IMZ and OMZ are 100% vegetated, then a fully protected IMZ accounts for 57.5% of the total MZ area (115 ft/200 ft). Only an additional 7.5% of the total area needs to be retained to achieve 65% vegetation retention in the entire MZ, which means that virtually the entire OMZ can be cleared and will provide no additional function. In urban areas, however, existing vegetation in the IMZ is often less than 100%, which allows for additional protection of the OMZ up to the 65% vegetation retention standard for the entire MZ.

Water Type F (steep ravine delivered directly to marine shorelines), Rural and Urban Standard: The standard for Water Type F is a 200-ft wide MZ, with an IMZ 100 ft wide or 25 ft wide from the top of the steep bank, whichever is greater.

[19] Vegetation retained in the OMZ is also important, as it would protect the IMZ and provide an increment of additional benefits.

As a general rule, an IMZ width of 100 ft would not provide adequate protection for all listed functions, including microclimate, wildlife habitat, and large woody debris recruitment, and potentially sediment filtration, which often requires buffers wider than 200 ft in areas of steep slopes. However, by definition, the types of streams that are addressed in this standard discharge directly to marine shorelines that commonly have steep slopes. In these cases the actual IMZ widths would be far greater than 100 ft and the streams are unlikely to be inhabited by chinook salmon because of steep gradients.

Water Type N (within 1/4 mile upstream of Type S or F water), Rural and Urban Standard: The standard for Water Type N is a 115-ft IMZ, with no required OMZ. The purpose of this designation is to create a transition zone that would provide an accumulation of benefits to downstream type S and F (fish-bearing) waters and serve as a buffer from upstream effects. Important functions include water supply (magnitude and timing of flows), temperature control, sediment control, nutrient control, and prey production (Binford and Buchenau 1993; Wenger 1999; Beschta et al. 1987). Based on the recommendations in Tables 4-2 to 4-4, an IMZ width of 115 ft with no CMZ or OMZ would not fully provide protection for most riparian buffer functions such as large woody debris recruitment, microclimate, wildlife habitat, sediment filtering, pollutant removal, and water temperature through shading. In some cases, some functions may be fully provided, depending on stream characteristics (e.g. adequate shading on very small streams), but that would not be the case as a general rule. However, a 115 MZ would provide some accumulation of habitat benefits to downstream type S and F waters. For example, if the riparian corridor of a type N stream does not fully provide for large woody debris recruitment, an accumulation of some large woody debris and other organic input would still be delivered downstream. The same logic holds true for any riparian function, in particular those that affect water quality.

Water Type N (greater than 1/4 mile upstream of Type S or F), Rural and Urban Standard: The standard for these waters is a 65-ft wide IMZ. The purpose of this designation is to provide a protective area for the transition zone (type N < ¼ mile upstream of type S or F) and for the contribution of benefits to downstream waters. These habitats are invariably small headwater channels or wetlands. Important functions in type N waters are water magnitude and timing of flows, temperature control, sediment control, nutrient control, and prey production (Binford and Buchenau 1993; Wenger 1999; Beschta et al. 1987).

Based on the above recommendations, a 65-ft IMZ would not provide adequate protection for all the riparian functions listed in Tables 4-2 and 4-4. Furthermore, it is questionable whether riparian buffers that are insufficient to fully protect habitat functions in non-fish bearing type N streams would provide an accumulation of benefits to downstream type S and F waters.

IMZ Width Averaging

The Model assumes that IMZ width averaging, as allowed under the Land Management Program, should provide the same level of protection as would occur without averaging. The area of the IMZ may be averaged if the width of the IMZ is not reduced to below 75% of the standard at any given point. Encroachment also should not occur between the stream and steep banks or into a CMZ, and should not extend into a wetland buffer. The area of the IMZ would be equivalent before and after IMZ averaging, and the proposed activity would not preclude the opportunity for future improvement of structure and function of the area.

Natural riparian corridors are generally variable in width because they are transition zones between upland and wetland areas that are subject to dynamic changes from variable flood regimes and channel forming processes. These dynamic processes typically lead to a high edge-to-area ratio and contribute to the increased habitat complexity and structural diversity important to aquatic and upland habitats

(Thomas 1979; Bilby 1988). If the IMZ width is not substantially reduced at any given point, then there are no additional points along the stream that are more susceptible to allowing overland or stormwater flow to be delivered directly into the stream. The equal area provision ensures that the area of no impact will not change, which effectively increases the width of the no-touch zone in some sections of MZ, while decreasing it in others. In addition, protection is still provided to the CMZ, wetlands, and steep slope areas, and OMZ regulations will be in place so that the overall MZ width is not reduced. Similar buffer width averaging regulations have been successfully implemented in Snohomish County. Both the Snohomish County regulations and the Model regulations require supervision of qualified biologists, with the additional provisions that vegetation quality and quantity are comparable before and after averaging.

Allowing variability in buffer widths is an ecologically valid principle. However, because it is difficult to predict the standards for vegetation retention, averaging, and exemptions that will be applied to individual sites, it is difficult to predict that the structure and function of the IMZ will be equivalent before and after averaging. However, the effectiveness of buffer-width averaging has been demonstrated in Snohomish County, where additional criteria for the biological effectiveness of the vegetation cover are included. With effectiveness monitoring conducted under the Monitoring and Adaptive Management and WRIA Based Planning Programs, application of averaging can be assessed and additional criteria developed, if needed, to ensure equal structure and function of the IMZ.

IMZ Restrictions and Exceptions

In general, no development activity would be allowed in the IMZ, and the IMZ would be placed in a separate, protected tract such as a native growth protection or conservation easement. Allowed exceptions within the CMZ of the IMZ generally consist of maintenance of lawfully established existing structures, provided that the location and extent of those structures are not changed or expanded. Streambank stabilization to protect new structures from future channel migration would not be permitted, unless achieved by planting native vegetation. Up to 35% of the CMZ could be cleared for the purposes of timber harvesting, firewood harvesting, and recreation, only if conducted at least 150 ft from the BCE. If a channel migrates laterally more than 150 ft from an existing BCE, then riparian functions may be reduced. See Appendix G for a list of IMZ restrictions and exceptions.

Restrictions on allowed activities within the IMZ should provide an adequate measure of protection (assuming adequate compliance with regulations) because expansion of the extent and location of development activities is not permitted unless located beyond 150 ft from the BCE. While violations of regulations would likely contribute to stream habitat degradation, it is not within the scope of this biological review to determine the extent of such violations and the magnitude of subsequent impacts on stream function. This biological review assumes adequate enforcement of regulations.

OMZ Regulations

Development activities in the OMZ would have setback provisions and be sited to avoid creation of future hazard trees, minimize impacts on groundwater movement and avoiding filling of wetlands. In addition, no new effective impervious surfaces would be allowed, erosion control measures would be required pursuant to the Stormwater Management Program, and clearing and grading activities would have to be managed so hydrologically mature vegetation can be established where it does not currently exist. See Appendix G for a list of OMZ regulations.

Development activity disturbance allowed within the OMZ is greatly restricted and designed to effectively maintain and prevent degradation of existing soil and vegetation conditions within the OMZ. In addition, no effective impervious area (EIA) would be allowed in the OMZ, and hazard tree removal would not allow removal of the entire tree unless it was converted to deadfall within the IMZ.

Wetland Buffers

The Model specifies that a minimum buffer of 100 ft shall be maintained around any wetlands within the MZ, except on type N waters greater than ¼ mile upstream of a type S or F stream, where the wetland buffer would be 65 ft.

These buffers would provide additional protection of wetlands within the MZ. Wetlands beyond the MZ boundaries would not be protected under the Model, but would be protected to the extent provided by other existing state and federal laws or local regulations.

Retention of Vegetation within the MZ

The Land Management Program requires a minimum of 65% vegetation retention within the entire MZ (IMZ and OMZ combined). No new impervious surfaces are allowed within the IMZ, with a few exceptions. This program also sets a threshold of 0% for new effective impervious surface area within the OMZ. It assumes that for the development and redevelopment of rural residential zoned sites (sites located outside the UGA that are zoned for single family residential use), the area outside the MZ will have a threshold of 10% effective impervious surface.

Forest retention standards and impervious area limits are ecologically sound principles. Section 4.3.2.2 provides further discussion of applying the Rural 65/10 Residential Site Standard. In addition, minimizing habitat fragmentation is a well-accepted principle of riparian ecosystem management. As with IMZ averaging, evaluation of structure and function of riparian areas would be required. Equivalent structure and function would be monitored through the Monitoring and Adaptive Management and WRIA Based Planning Programs, as specified in the Model.

Additional Considerations for Urban Riparian Habitat Protection

Streams in high-intensity land use areas are generally highly degraded, while streams in areas of low-intensity land use are generally in better condition and offer more opportunities for salmonid conservation or restoration habitat improvement efforts. As described earlier, literature suggests that wider buffers may be necessary to provide adequate protection for stream habitat processes in high-intensity land use areas. The Model MZ regulations propose the opposite; smaller buffers in high-intensity land use areas, which is not consistent with the literature. However, the Model assumes that in highly developed areas there is a point beyond which requiring wider buffers for the few remaining undeveloped sites does not significantly contribute to conservation goals. In this context, some improvement is still possible, but would likely entail highly engineered and costly solutions. Wider buffers for generally less degraded habitat places a higher priority for protecting areas that retain more improvement potential and is consistent with recommendations for salmonid restoration initiatives (NMFS 1996). Further analysis of the implications of providing smaller buffers within the UGA of the Tri-County region relative to existing chinook salmon and bull trout populations is presented in Section 5.4.

There are areas within UGAs that contain relatively high-quality riparian and stream habitat that either directly or indirectly support spawning populations of chinook salmon or provide rearing, migration, and/or feeding habitat for chinook salmon and bull trout and where the habitat is in either currently good condition or has the potential to be restored improved to such. The urban MZ standard of a 115-ft IMZ and an 85-ft OMZ (with no vegetation retention standards beyond the MZ) would not be sufficient to achieve PFC of habitat indicators and riparian functions that largely rely on riparian buffers and natural habitat-forming processes. For example, an IMZ of 115-ft would not provide for 100% large woody debris recruitment function (see Section 4.3.1.1). Because large woody debris is particularly vital for channel formation processes in Puget Sound lowland streams, and recruitment would be difficult and

unreliable by artificial means, thus PFC probably cannot be achieved with much certainty without an adequate buffer width.

The urban MZ standard essentially creates a ceiling for large woody debris recruitment potential that is below properly functioning condition. Other indicators and functions limited by the inadequate riparian buffer include pool frequency, pool quality, width-to-depth ratio, microclimate, floodplain connectivity, and riparian reserves (see section 4.3.1.1 for further discussion of riparian buffer width functionality). Incremental improvements to habitat functions in the long term could not conceivably achieve properly functioning conditions for some indicators. This result would occur regardless of the status of other indicators that are not as reliant on riparian buffers or that are generally better supported by a 115-ft IMZ (e.g. sediment filtration, streambank condition, organic litter input).

Areas requiring greater protection have not been clearly identified. Criteria for designation of high-priority areas should include the presence of chinook salmon and bull trout, existing land use, and existing riparian condition characteristics. In the process of formulating the Model MZ regulations, the opinions of 13 regional experts (including civil engineers, aquatic biologists, hydrologists, geomorphologists, and environmental planners) on the criteria necessary to designate highly-urbanized sub-basins were presented and summarized in Lucchetti et al. (2001). The intent of the survey was to determine the criteria necessary to qualify a sub-basin for less-protective buffer widths (in this case, less protective meant less than the rural standard). Criteria for determining habitat conditions included the level of total impervious area (in particular a 35% threshold), percentage of buildout (% of urban lots containing structures), and the percentage of riparian intactness (% of the area within 100-ft of the OHWM that is intact). Presumably, criteria useful for identifying areas that qualify for less-protection would be the inverse of criteria useful for identifying areas that would qualify for greater protection.

The strongest consensus of the report was that if MZ width variance is to be considered in urbanized sub-basins, then other criteria should be considered in addition to or in lieu of those listed above. The main suggestions were to evaluate where impervious surfaces are concentrated in sub-basins and to evaluate the relative biological significance of particular sub-basins. These additional criteria provide contextual support for requiring greater protection where it would benefit chinook salmon and bull trout. Indicators of biological value may include significant existing populations, identifiable rearing/spawning habitat, important migration/feeding habitat, or areas with the potential for improvement of natural processes that would benefit populations.

Where high-priority areas are identified, additional protective measures may need to be defined. This may be accomplished simply by requiring application of a standard greater than the prescriptive urban standard to that portion of the sub-basin of concern or protecting such areas through habitat acquisition or conservation easements.

4.3.1.3 Site-Specific Habitat Evaluation Option

An alternative to the fixed-regulations option under the Land Management Program is the site-specific habitat evaluation option. The Model specifies that use of this option for evaluating a proposed development activity requires a habitat evaluation to determine a site's natural habitat functions (inherent site potential). It specifies identification of those functions that would be precluded by existing permitted development and if the project, as proposed, is consistent with the habitat objectives and sub-objectives contained in the Model. The habitat evaluation shall provide an analysis of the proposal's short-term, long-term (temporal), and cumulative impacts. In addition, the habitat evaluation requires an analysis of the potential for the project to preclude future habitat improvement opportunities. A local government may approve a project proposal only if the habitat evaluation demonstrates that the habitat objectives are being met and that there is no preclusion of future habitat improvement opportunities.

The scope and scale of the habitat evaluation would depend on the scope and complexity of the proposed project. If the habitat evaluation predicts adverse effects, it shall incorporate conservation measures sufficient to fully mitigate for the adverse impacts of the proposal.

Habitat Evaluation Overview

The purpose of a site-specific habitat evaluation is to ensure the identification and preservation of the processes that form habitat and that are important for salmonid conservation. Using the best available science, the effects of a development activity on a site's natural potential for providing a given habitat function or component will be identified and quantified to the extent practicable in the habitat evaluation. The effects will then be extrapolated to assess impacts on the species as a whole, based on relationships between habitat condition and population viability.

Ideally, reliable scientific information on the biological requirements of a species would exist at both the population and the ESU levels, and effects on habitat would be readily quantifiable in terms of population impacts. In the absence of watershed or sub-basin specific habitat conditions and requirements, the habitat evaluation shall rely on generally applicable scientific research that can be reasonably extrapolated to estimate habitat impacts of individual projects at small scales.

Actions that affect biological requirements and processes are usually measured by the Services against PFC, as discussed in Chapter 1. Consistent with the PFC approach, the habitat evaluation used under this option would be based on site-specific evaluation of the effects on habitat functions and processes necessary to meet habitat objectives. The specific elements of the habitat evaluation are presented in Appendix H.

The site-specific habitat evaluation option should provide adequate protection to stream habitat functions and be consistent with salmonid conservation goals. A local government may approve a project proposal only if the habitat evaluation demonstrates that habitat objectives and sub-objectives are consistent with the PFC approach and are approved by the Services. The habitat evaluation used under this option would be based on site-specific evaluation of the effects on habitat functions and processes necessary to meet habitat objectives.

4.3.1.4 Programmatic Habitat Evaluation Option

The third option under the Land Management Program is the programmatic habitat evaluation option. The Model states that this option shall be prepared by, or overseen and approved by, the corresponding local government, and shall be subject to final review and approval by the Services. The programmatic evaluation would examine a pre-determined geographic area or a type of project activity. The evaluation would use the habitat evaluation methods described above (and further detailed in the Model), or an otherwise scientifically sound evaluation methodology, determines a programmatic strategy to protect and improve habitat essential to salmonids within the specified geographic area. The evaluation would also identify potential effects of proposed development and redevelopment in the geographic area. The programmatic strategy would establish a tailored set of development regulations and conservation measures that address the protection and improvement of habitat essential to salmonids, which would subject it to analysis under the PFC test.

The programmatic habitat evaluation option would provide adequate protection to stream habitat processes and be consistent with salmonid conservation goals because it requires review and approval by the Services.

4.3.1.5 Mitigation Requirements and Guidelines Overview

Appropriate mitigation would be required as outlined in the Model for any loss of salmonid habitat area, functions, and values caused by development activities subject to the regulations described in the Model. Mitigation shall also be required for loss of opportunity for future improvement of additional functions that would be expected to naturally occur at that site. First and foremost, however, all reasonable planning and precaution shall be executed to avoid actions that would have any affect on salmonid habitat that necessitate mitigation.

Mitigation would be required for any effects caused by:

- The applicant's field activities involved in project planning and permit application,
- Project construction and implementation,
- Ongoing project operation and maintenance,
- Any human or domestic-animal activity that the presence of the project stimulates, causes, or enables, and
- Preclusion of the opportunity for improvement of additional functions that would be expected to occur at that site in its natural condition.

Major components of the model mitigation guidelines are presented in Appendix I.

The Model's mitigation requirements are extensive and provide certainty that stream habitat functions and processes would not be compromised by development activities. Mitigation requirements apply not only to individual projects using the fixed regulation or site-specific habitat evaluation options, but also to programmatic habitat evaluations. Any identified loss of function or opportunity identified in programmatic evaluations shall be mitigated, and mitigation plans would be approved by the Services where a jurisdiction seeks a take limit or other assurance under an ESA 4(d) Rule.

4.3.2 Stormwater Management Program

The Tri-County 4(d) Stormwater Management Program has 14 elements and integrates the requirements of the Clean Water Act (CWA) and the ESA to the extent possible. This integration is intended to ensure that implementation requirements of the two statutes are consistent, and to make the most efficient use of existing stormwater management programs to meet new ESA requirements.

The focus of many of the 14 programmatic elements is to address stormwater impacts from both new development and existing development. Requirements for a stormwater capital improvement program (CIP) and for habitat enhancement and acquisition programs are intended to compensate for impacts that cannot be fully mitigated by the other more regulatory elements (e.g., technical standards, inspection and enforcement, maintenance, etc.). The land use element, and to a great extent, the habitat acquisition element, are intended to prevent or reduce the addition of impervious area, which is recognized as a root cause of stormwater impacts.

The 14 mandatory Stormwater Management Program elements are guided by the following principles:

- All 14 of the recommended programmatic elements must be implemented according to prescribed timelines.

- The Stormwater Management Program has been closely coordinated with CWA implementation requirements to ensure consistency and efficient, cost effective implementation.

- Stormwater management must be analyzed and considered as part of land use planning because stormwater regulations and facilities cannot fully mitigate the impacts of land use development. For the same reason, habitat enhancement and acquisition are fundamental to a comprehensive system of habitat protection.

- While the 4(d) rule is in effect, participating jurisdictions must adopt regulations that are consistent with minimum standards; incorporate new information into their stormwater management programs;adopt maintenance, inspection and enforcement standards; provide public outreach on the Stormwater Management Program, and utilize the National Pollutant Discharge Elimination System (NPDES) permit review process to provide for stakeholder review.

The 14 elements of the Stormwater Management Program are described below:

1. Land Use Decisions and Regulations: Jurisdictions must assess and consider stormwater impacts when land use decisions are made, encourage developers to use innovative construction and development techniques that reduce stormwater runoff, and adopt development standards to reduce effective impervious surfaces and retain native vegetation.
2. Technical Standards: The Model requires the updated Ecology Manual (Ecology 2001) or equivalent to be adopted within 24 months of certification, but Ecology will require all jurisdictions to adopt the updated Ecology Manual by 2003 or sooner, regardless of implementation of the Model. Highlights of the technical standards include the following;
   - Prohibit clearing of land without approved clearing plans.
   - Match peak flows and erosive flow durations from newly developed and redeveloped areas to conditions that existed prior to development in the Puget Sound region.
   - Infiltrate the water on each development as much as possible.
   - Treat at least 90% of annual runoff from new and redeveloped pollution-generating surfaces.
   - Apply erosion and sedimentation control BMPs to all development activities and require construction stormwater pollution prevention plans for projects that add or replace 2,000 ft^2 of impervious surface or more, or clear more than 7,000 ft^2.
3. Inspection/Enforcement: Jurisdictions must ensure compliance with standards established in the Stormwater Management Program by enacting ordinances to adopt the Stormwater Management Program and adequately funding development review and inspection, compliance monitoring, complaint response, and enforcement actions.
4. Maintenance Standards: Jurisdictions must have maintenance standards and programs for ensuring proper and timely maintenance of public and private stormwater facilities.
5. Source Control: Jurisdictions must adopt source control standards equivalent to or better than those required by the Washington State Department of Ecology (Ecology). These standards are intended to minimize runoff pollution; control the discharge of non-stormwater spills and disposal of materials; and reduce pollutants associated with the application of pesticides, herbicides, and fertilizers. Jurisdictions must establish and fund source control programs for inspecting existing commercial, multifamily, and industrial sites to enforce adopted source control standards.
6. Illicit Discharge: Jurisdictions must have or participate in a program for preventing, detecting, and removing illicit discharges from existing commercial, multifamily, and industrial sites.

7. Public Education: Jurisdictions must implement programs to educate their citizens about the role their activities have on water quality, stormwater runoff, and protection of listed species.
8. Public Involvement/Outreach: Jurisdictions must implement programs to ensure public involvement in the jurisdictions' decision making process involving stormwater management programs and priorities.
9. Governmental Coordination: Jurisdictions shall have a program or policy directive for ensuring that adequate inter-jurisdictional agreements exist for controlling stormwater runoff conveyed between jurisdictions and for coordinating with other jurisdictions on watershed and basin planning efforts and activities.
10. Monitoring: Jurisdictions must have or participate in a program for monitoring the implementation of stormwater management activities and for gathering, maintaining, and using adequate information to conduct planning, priority setting, and program evaluation activities.
11. Stormwater Planning: Jurisdictions must have a program for participating in planning efforts within watersheds and for doing more detailed stormwater planning to assess stormwater impacts from existing and future development and to identify and prioritize cost effective mitigation of those impacts. This stormwater planning would be coordinated with WRIA based planning.
12. Capital Improvement Program: Jurisdictions' CIP projects shall be designed so that protective measures for salmonid habitat are incorporated to the maximum extent practicable. The ranking process to determine which CIP projects are carried out should include consideration of which projects are considered less harmful to salmon and salmon habitat. CIPs shall include projects that attempt to mitigate past land disturbing activities/practices.
13. Habitat Enhancement/Rehabilitation: Jurisdictions shall have or participate in a program for constructing habitat enhancements to compensate for stormwater impacts that remain unmitigated by technical standards applied to new development and for ensuring their long-term viability and protection through formal stewardship. This program should include a ranking process for evaluating habitat enhancements such that those most advantageous to salmonids are given a priority ranking.
14. Habitat Acquisition: Jurisdictions shall have or participate in a program for acquiring and managing lands in a manner supporting the long-term ecosystem processes that create and maintain habitats used by salmonids.

The technical concepts that form the basis of the technical standards and land use regulations described above are listed below and evaluated in the following text:

- Flow dispersion and infiltration,
- Rural area impervious area limits and forest retention (the Rural 65/10 Residential Site Standard),
- Engineered flow control facilities to mitigate increases in peak flows and erosive flow durations,
- Flow control thresholds used in design of engineered flow control facilities, and
- Water quality treatment to remove pollutants and prevent toxicity.

The Stormwater Management Program does not rely solely on these technical concepts. The program's requirement for stormwater planning is intended to identify the actions necessary to address cumulative incremental impacts (e.g., the effects of sites below the flow control threshold) and residual impacts (e.g., uncontrollable increases in runoff volume and decreases in base flows). At a minimum, a Stormwater Flow and Water Quality Improvement Plan must be prepared by the jurisdiction; the schedule for preparation of the stormwater plan is required to be established within 18 months of certification. Where

basins cross jurisdictional boundaries, stormwater planning/study would be coordinated among affected jurisdictions. Stormwater plans would include implementation schedules for actions proposed in the plan. The plan would link together the elements within the Stormwater Program, and as necessary, modify or supplement the early-action elements of the program. Stormwater planning also links the Stormwater Management Program to the Model's long-term programs: Monitoring and Adaptive Management, Habitat Acquisition and Restoration Funding, and WRIA Based Planning Programs.

Actions included in a stormwater plan may include:

- Adopt basin-specific stormwater technical standards,
- Make adjustments in stormwater programs and activities,
- Identify the need for and rank stormwater capital projects,
- Identify the need for and rank habitat preservation and improvement projects,
- Recommend WRIA-level consideration/analysis of land use/zoning changes (including forest retention/impervious surface restrictions), and
- Recommended GMA comprehensive plan consideration/analysis of land use/zoning changes (including adjustment of urban growth boundaries).

According to the Model, jurisdictions must submit reports to the certifying federal agencies on the status of actions identified in previous plans, as well as any adjustments to the actions and schedules. This requirement is important to ensure that jurisdictions remain accountable and keep stormwater plans up to date.

The following evaluation of technical concepts is based on current literature assumed to represent best available science. The Model includes an adaptive management element that will be used to monitor the effectiveness of these programs and elements, incorporate new external scientific information, and update the programs, as necessary, to ensure they remain current with the state of the science.

The Stormwater Management Program addresses several elements of the hydrologic cycle. McCuen (1989) summarizes the hydrologic cycle as follows:

> "Rain falling on the Earth may enter a water body directly, travel over the land surface from the point of impact to a watercourse, or infiltrate into the ground. Some rain is intercepted by vegetation; the intercepted water is temporarily stored on the vegetation until it evaporates back to the atmosphere. Some rain is stored in surface depressions, with almost all of the depression storage infiltrating into the ground. Water stored by depressions, water intercepted by vegetation, and water that infiltrates into the soil during the early part of a storm represent the initial losses, where the loss is water that does not appear as runoff during or immediately following a rainfall event. Water entering the upland streams travels to increasingly larger rivers and then to the seas and oceans. The water that infiltrates into the ground may percolate to the water table or travel in the unsaturated zone until it reappears as surface flow [this is called interflow]. The amount of water stored in the soil determines, in part, the amount of rain that will infiltrate during the next storm event. Water stored in lakes, seas, and the oceans, evaporates back to the atmosphere, where it completes the cycle, and is available for rainfall. Water also evaporates from the soil devoid of vegetation. Rain that falls on vegetated surfaces may be intercepted; however, after the storage that is available for interception is filled, the water will immediately fall from the plant surfaces to the ground and infiltrate into the soil, much as water on bare ground infiltrates. Some of the water stored in the soil near plant is taken up by roots of the vegetation, and subsequently passed back to the atmosphere from the leaves of the plants; this process is called transpiration [evaporation plus transpiration is called evapotranspiration]."

The effects of the Stormwater Management Program on interception, evapotranspiration, infiltration, interflow, and surface runoff are discussed below.

4.3.2.1 Flow Dispersion and Infiltration

In the Tri-County region, most precipitation not lost to evapotranspiration (ET) enters shallow soils (interflow) or deeper soils (groundwater); interflow and groundwater discharge are the means by which most flow naturally reaches streams (Beyerlein 2000; Booth 2000). The Stormwater Management Program prescribes three kinds of infiltration and/or dispersion practices that would contribute to sustaining water entry into the soil. Each of these practices would be expected to reduce the impacts to base flows and temperature from new impervious surfaces, but as discussed below, the practicability of these practices would vary from site to site. Overall effectiveness would be uncertain at the watershed scale. Each type of infiltration/dispersion is discussed individually.

- New development is required to minimize EIA by first attempting to fully disperse runoff from new impervious surfaces and cleared areas. Because full dispersion requires runoff to be spread through a substantial flow path of undisturbed native vegetation (100 ft or more), it would be expected to allow the majority of runoff to infiltrate. However, topography and other site constraints may make full dispersion impracticable on an unknown number of sites.
- New lawn and landscaped areas are required to be amended with compost tilled into the soil surface. This practice can significantly improve detention/infiltration and reduce storm runoff from lawn and landscaped areas, especially on the sand, clay, or compacted glacial till soils common to this region (Kolsti et al. 1995, as reported by Marx et al. 1999).
- Where runoff cannot be fully dispersed, infiltration/dispersion BMPs must still be used to the maximum extent practicable (in conjunction with a duration control facility, if required). Infiltration/dispersion BMPs have much shorter flow path lengths (i.e., 25 and 50 ft) spread through any type of vegetation. Landscaped areas and lawns generally have water retention capacity significantly less than natural forest soils (Booth and Jackson 1997; Booth 2000), but as described above, soil amendments would improve water retention capacity and infiltration.
- Duration control facilities (see discussion of flow control facilities in Section 4.3.2.3) may include infiltration facilities to meet a specific discharge target. Infiltration, if applied on a broad scale to new development and redevelopment, could help to maintain base flows and moderate stream temperatures. However, the Ecology Manual (Ecology 2001) requires that infiltration systems be situated at least 5 ft above hardpan or low permeability layers. Approximately 73% of the Tri-County lowland area has till hardpan soils at or near the surface (Snyder et al. 1973; Zulauf 1979; Debose and Klungland 1983). Thus, infiltration would not be practicable in these areas.

As stated above, most water naturally reaches streams via infiltration and interflow. It follows, then, that where stormwater must be managed, flow dispersion and infiltration will result in the most natural possible flow hydrograph and water chemistry reaching the water body. Therefore, this technical concept is ecologically sound. However, as discussed above, the effectiveness of dispersion and infiltration on a watershed and regional scale is uncertain and difficult to predict.

4.3.2.2 Rural 65/10 Residential Site Standard

The Stormwater Management Program requires regulations limiting EIA to 10% and maintaining a minimum of 65% forested area on rural residential sites, with full dispersion of runoff from new

impervious surfaces to the maximum extent practicable[20]. Booth (2000) summarizes numerous Puget Sound regional studies that identify these levels of clearing and imperviousness as approximate thresholds at which stream channels transition to severely degraded conditions. Booth notes that slight to severe damage to aquatic systems is likely to occur at levels of imperviousness above 10% or forest cover reduced below 65%. Booth does not identify the complete suite of other factors that relate to the effectiveness of this threshold, but soil type is specifically identified—where outwash soils are predominant, almost no natural runoff occurs and impervious areas (without mitigation by infiltration BMPs) result in proportionally large flow increases. Studies such as Booth (2000) are based on watershed impervious area, while the Rural 65/10 Residential Site Standard is applied on a site basis. The outcome of site applications is discussed in Chapter 5.

Booth (2000) notes that:

> "The thresholds… do not separate a condition of 'no impact' from that of 'some impact;' instead, they separate the condition of 'some impact' from that of 'gross and easily perceived impact.' … Every increment of cleared land, and of constructed pavement, is likely to result in some degree of resource degradation or loss."

These thresholds also apply to stream channel condition. Biological condition may respond differently to impervious area and forest clearing. Booth (2000), Horner and May (2000), and Karr and Chu (2000) also establish that no apparent impervious area threshold exists that causes a notable break in *biological* condition, but rather that biological conditions demonstrate a continuum of response to impervious surface coverage.

Other flow control and treatment measures would need to be implemented to mitigate for areas already cleared/developed in excess of 65/10, areas where the standard would not apply, and areas where monitoring demonstrates that the 65/10 standard does not adequately maintain base flows. May (1997) and Horner and May (2000) demonstrate that riparian buffer condition affect stream biological condition at a magnitude equal to basin imperviousness: the MZ standards proposed in the Land management Program may offset some impacts caused by increased impervious area.

Booth (2000), Horner and May (2000), and Karr and Chu (2000) demonstrate a positive correlation between forest retention and biological condition, and a negative correlation between EIA and biological condition. Therefore, it follows that forest retention and impervious area are ecologically sound principles; the specific thresholds would require sub-basin scale monitoring to confirm their effectiveness. An increased standard may be necessary in some sub-basins. Forest retention and impervious area standards, combined with full dispersion BMPs to the maximum extent practicable (as called for in the Rural 65/10 Residential Site Standard) will reduce the effect of impervious surfaces and cleared areas in rural residential developments and in maintaining stable stream channels.

The Model does not apply impervious area and forest clearing limits within urban sub-basins. The Model relies on other measures to be implemented through stormwater planning and CIPs, and the long-term programs to maintain or improve the functions provided by impervious area and forest-clearing limits. We don not foresee that these other measures would effectively maintain or improve base flows.

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[20] Effective impervious area can be limited by limiting total impervious area or by preventing all or part of the total impervious area from becoming hydraulically connected to streams via collection systems and pipes. The Stormwater Management Program credits both methods for limiting EIA—either by minimizing total impervious surface or by fully dispersing and infiltrating runoff from the impervious area in adjacent native-vegetated pervious areas.

4.3.2.3 Engineered Flow Control Facilities

Flow duration control facilities are required for new impervious surfaces, new cleared areas, and for all replaced impervious surfaces. They are also required for modified cleared areas that produce 100-year peak flows of 0.1cfs, or more than would be produced by the site condition that existed prior to any development in the Puget Sound region[21] (see below). In addition, infiltration/dispersion BMPs are required for all such surfaces, subject to limits of practicability[22] and exceptions.

Beyerlein (2000) demonstrates that engineered surface water control facilities, as they are currently required (without infiltration/dispersion BMPs) cannot replace the hydrologic regime equivalent to the natural forested condition. Specifically, Beyerlein notes:

> "Engineered facilities do not address decreases in evapotranspiration (ET) caused by deforestation and development. In naturally forested areas in the Tri-County region, ET returns nearly half of rainfall to the atmosphere. ET from cleared and impervious areas returns less annual rainfall to the atmosphere (i.e., about 30% for suburban residential, and less than 20% for completely impervious areas). The balance of water enters streams primarily as surface flows."
>
> "Of the rainfall not lost to ET, in a naturally forested condition, the majority enters groundwater, and is discharged to streams over a much longer time period, including summer base-flows. With runoff collection, detention, and surface discharge, only a fraction of rainfall reaches groundwater. Engineered flow control facilities do not address base-flow impacts caused by decreased groundwater recharge."

The regulations allow waiver of the detention facility requirement if flow increases are less than 0.1 cfs for the 100-year flow. This is not necessarily inconsistent with best available science, as it is not practicable and often counterproductive to concentrate and detain these small flows. These sites must still disperse and infiltrate stormwater to the maximum extent practicable. If a significant number of sites within a given sub-basin qualify for this exception, monitoring and stormwater planning could be used to identify and mitigate cumulative incremental impacts. This would rely on jurisdictions to proactively examine typical development patterns to predict whether a significant number of sites would develop in a manner that does not meet flow control thresholds, so that monitoring would be started before additional development occurred.

Modeling of these facilities requires continuous simulation methods that represent best available science. These simulations indicate that engineered flow control facilities using the flow duration control standard will prevent increases in erosive flow durations for the targeted range of flows. However, extensive empirical monitoring has not been performed to confirm the performance of facilities designed with these methods.

The Model requires that facilities be designed to match the discharge durations for the site condition that existed prior to any development in the Puget Sound region. Absent information regarding the original site condition, the predevelopment condition must be assumed to be forested. Matching flows to forested conditions provides the most conservative flow target for matching flows, and thus represents best available science.

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[21] Except for runoff discharged to major receiving waters where increased flow rates would be negligible relative to the size of the water body.

[22] Practicability is partly a measure of technical feasibility, but is also a standard by which incremental advances in treatment are gauged against the corresponding financial burden.

The use of engineered facilities for peak flow and duration control is a sound technical principle for controlling flow increases from new development and redevelopment. This conclusion only applies to the concept of using flow controls to maintain and improve peak flows and durations (the soundness of implementation details and thresholds are discussed in the subsections below). Some areas will fall below the threshold requiring flow controls; other requirements of the Stormwater Management Program (e.g. the 65/10 Rural Residential Site Standard in rural areas, and soil amendments, full dispersion, and infiltration/dispersion BMPs in all areas) would still apply to these sites, and would reduce the effects of the potential incremental flow increases (see Section 4.3.2.1).

The flow control facilities as proposed would not effectively maintain or improve base flows. Infiltration and dispersion (Section 4.3.2.1) and impervious area and forest clearing limits (Section 4.3.2.2) would be necessary to maintain interflow and groundwater recharge, and in turn, base flows.

4.3.2.4 Thresholds for Flow Control

The flow duration standard would be applied for flows occurring between a lower threshold of 50% of the 2-year natural discharge rate ($½Q_2$) and an upper threshold of the full 50-year flow rate (Q_{50}). Each of these thresholds is evaluated separately below.

4.3.2.5 Lower Threshold at 50% of the 2-Year Natural Discharge Rate

The lower threshold of the flow control standard is set at $½Q_2$. This is generally estimated to be the threshold of bed material mobilization (King County 1998). Booth (1993) reviewed several studies that demonstrate that the lower threshold of bedload movement is approximately at or near this level. However, this means that some undetained flows less than this threshold may or may not be erosive.

The duration control standard has not been implemented for a long enough period of time or over enough of a sub-basin to measure or otherwise confirm its effectiveness. The effect of increased flow durations for flows less than $½Q_2$ on salmonids and salmonid habitat has not been determined.

The $½Q_2$ threshold is not an empirically or theoretically proven concept. Therefore, it may not be protective. Several years of instream flow monitoring in sub-basins primarily developed with the flow duration standard are needed to validate this threshold.

4.3.2.6 Upper Threshold at the Full 50-Year Natural Discharge Rate

The upper threshold of the flow control standard is set at the full 50-year natural discharge rate (Q_{50}). Flows in excess of Q_{50} occur only a small fraction of the time. When simulated by continuous runoff models such as the King County Runoff Time Series (King County 1995), these flows occur approximately several tens of hours over a 100-year period. When flows in excess of Q_{50} occur, a substantial portion of flow would be out-of-bank, with water spread out in the floodplain (thus not doing work in the channel). Within the floodplain these flows have lower velocity[23] and thus provide much less channel modification. Lower velocity flows in floodplains allow for sediment deposition. The portion of these flows within the stream channel would likely alter the stream channel in the same manner as would flows under natural conditions. Based on this weight of evidence, the Q_{50} is an appropriate upper threshold for flow controls; increases in flow durations for flows in excess of Q_{50} hours over the extreme long-term would not be expected to exert a significantly different effect on stream channels than unmodified high flows.

[23] Continuity dictates that for a given volumetric flow rate, a larger cross-sectional flow area will result in lower velocity. That is, *Q* (flow) = *V* (velocity) x *A* (cross-sectional flow area). For a given *Q*, as *A* increases, *V* decreases.

4.3.2.7 Water Quality Treatment of Stormwater Runoff

The goal of stormwater runoff treatment is to reduce pollutants in stormwater discharges to the maximum extent practicable consistent with the CWA. The water quality treatment BMPs listed in the Stormwater Management Program are equivalent to the King County and Ecology Basic Treatment Menus. IN addition, the 2001 Ecology Manual requires enhanced treatment for the most polluting developments that drain to fish-bearing waters (see note regarding treatment menus below).

The following process was used to assess the effectiveness of proposed water quality treatment BMPs:

- Determine typical pollutant concentrations in urban and suburban runoff,
- Determine expected pollutant removal rates,
- Estimate pollutant concentrations in runoff reaching streams, and
- Compare the post-treatment pollutant concentrations to effects thresholds.

The following analysis evaluates whether water quality treatment facilities proposed by the Model provide the appropriate order of protection to prevent lethal effects on chinook, bull trout, and their prey. As discussed in the conclusions of this analysis, lethal and sublethal water quality effects on these species are dependent on numerous factors and cannot be precisely predicted based on nominal runoff water quality data, facility treatment rates, and laboratory toxicity data.

Pollutant Concentrations in Urban and Suburban Runoff

The mean and median total suspended solids (TSS) and total metals concentrations from several regional and national studies are summarized in Table 4-6. These pollutants are among the most commonly measured in urban runoff and are presented throughout this analysis as general indicators of urban pollution. The results are representative of a wide range of urban and rural land use conditions. These pollutant concentrations would be untreated influent conditions prior to entering treatment facilities.

Table 4-6. Regional and National Urban Stormwater Quality Studies, Reporting TSS and Total Recoverable (TR) Metals Concentrations

Constituent	Units	Bellevue: Sturtevant Creek[a] (log-normal median)	Bellevue: BURP[b] (mean, median)	King County: (Metro 1982) (mean)	NURP[e]: (EPA 1983) (median)	Portland NPDES[f] (median)	Freeway Runoff (mean)	Median of Study Values
TSS	mg/L	82.3	50	–[c]	100	119	106[d]	100
Cu (TR)	µg/L	10.4	–	20	34	40	43[d]	34
Pb (TR)	µg/L	26.3	170	210	144	25	466[d]	157
Zn (TR)	µg/L	161.4	120	110	160	376	638[d]	161

[a] From Bellevue (1996), Sturtevant Creek, downstream site.
[b] Bellevue Urban Runoff Program. From Pitt and Bissonnette (1984). For Cu, Pb, and Zn, data reported as mean of grab samples.
[c] Indicates no data available, reported, or applicable.
[d] Highway runoff from Interstate 5 freeway in Seattle with 57,000 automobiles per day, 43 to 54 storm samples in 1980-81 (Chui, et al. 1982).
[e] National Urban Runoff Program.
[f] Portland (1993).

Expected Pollutant Removal Rates (BMP Effectiveness)

Expected pollutant removal efficiencies for selected BMPs were determined based on the results of a literature review (Table 4-7). These BMPs are the most commonly-implemented in the Tri-County region and are generally representative of the BMPs in the Stormwater Program Basic Treatment Menu. The sand filter BMP would be expected to represent filtration basins, vaults, and trenches. The wet pond BMP would generally represent wet ponds, vaults, and constructed wetlands; however, biological uptake and binding of pollutants to organic materials in wetlands would render treatment wetlands significantly more effective than ponds and vaults. The bioswale BMP would represent bioswales, filter strips, infiltration treatment, and bio-infiltration swales. Infiltration and bio-infiltration facilities would be more effective than bioswales and filter strips (Table 4-7).

Table 4-7. Expected BMP Pollutant Removal Efficiencies

	Pollutant Removal Efficiency (%)									Median of Typical Removal Rates
	Bioswale			Sand Filter			Wet pond			
Parameter	min	max	typ val	min	max	typ val	min	max	typ val	
TSS	68[c2]	83[c2]	75	70[c2]	96[c2]	90	40[e]	90[e]	80[e]	80
Total Copper	42[c1]	46[b]	45[b]	19[a]	70[c2]	30[a, c2]	10[c3]	47[d]	40[a, c3, d]	40
Total Lead	62[c1]	67[b]	65[b, c1]	65[a]	85[a, c2]	75[a, c2]	10[c4]	95[c4]	70[a, c4, d]	70
Total Zinc	*	*	63[b]	33[c2]	80[a, c2]	55[a, c2]	20[c4]	95[c4]	60[a, c4, d]	60

* insufficient data reported

References

[a] Austin (1990).

[b] Marselek, et al. (1996)

[c] UW PEPL (1996), reporting

1. Unpublished studies at Mountlake Terrace, WA and Dayton Ave., Seattle, WA.
2. Austin (1996), Austin (1990), Horner (1995), Alexandria (1993).
3. Minton (1993)
4. USEPA (1993)

[d] Comings (1998)

[e] AESI (1997), reporting Meadowview Park monitoring results (Newcastle, WA), and

1. USEPA (1993)
2. Austin (1990)
3. King County (1995)
4. Urbonas (1994)

Other references considered in this review included Metro (1992), Bellevue (1998), and Kulzer (1989)

The maximum and minimum ends of the treatment range, and a typical value, were determined for the reviewed studies, which consisted of both project-specific studies and compilations of other studies. These performance data represent the best available science reports of facility performance. Although the values chosen were weighted heavily on studies completed after 1990, some of the studies are for facilities designed to old standards that predate current (improved) standards. The actual performance of the facilities required by the Stormwater Management Program are likely to meet or exceed the reported data produced by facilities designed to less rigorous standards.

Note regarding treatment menus: The updated Ecology Manual requires enhanced treatment for multi-family, industrial, commercial, and arterial and highway road project sites draining to fish-bearing waters. Enhanced treatment BMPs are designed to provide a higher rate of dissolved metals removal than the basic BMPs reported in this analysis. Enhanced treatment BMPs are typically a treatment "train" of two or more facilities, systems that provide more treatment time (large sand filters), or that encourage higher

levels of biological treatment (treatment wetlands). The Model requires the updated Ecology Manual (or equivalent) to be adopted within 24 months of certification, but Ecology will require all jurisdictions to adopt the updated Ecology Manual by 2004, regardless of implementation of the Model.

It is assumed that the maximum treatment efficiency represents BMPs installed and operated under nearly ideal conditions, with regular maintenance. The minimum efficiency is assumed to represent BMPs inappropriately designed, or applied with poor maintenance. The typical value is assumed to represent BMPs installed per standard design under typical conditions, with regular maintenance.

Pollutant Concentrations in Runoff Reaching Streams

To estimate post-treatment pollutant concentrations, median pollutant concentrations (from Table 4-6) were reduced by the median removal rate (from Table 4-7). The resulting post-treatment pollutant concentrations are presented in Table 4-8.

Table 4-8. Post Treatment Pollutant Concentrations

Parameter	Median Pretreatment Pollutant Concentration (from Table 4-6)	Median Pollutant Removal Rate (from Table 4-7)	Resulting Post-Treatment Concentration (Metals are Total Recoverable)
TSS	100 mg/L	80%	20 mg/L
Total Copper	34 µg/L	40%	20 µg/L
Total Lead	157 µg/L	70%	47 µg/L
Total Zinc	161 µg/L	60%	64 µg/L

Comparison of Post-Treatment Pollutant Concentrations to Effects Thresholds

The predicted copper and zinc concentrations presented in Table 4-8 are compared with 96-hour exposure toxicity thresholds for chinook salmon, brook trout, and *Daphnia* spp. (Table 4-9 from USEPA 1985, 1987; no data were immediately available for lead). Daphnia are included as a general representation of invertebrate prey species. No specific toxicity data were available for bull trout, thus brook trout (*Salvelinus fontinalis*) was used as a surrogate species based on the relationships developed in Suter et al. (1983). The untreated and predicted treated runoff pollutant concentrations estimated above are for stormwater; the 96-hour exposure is representative of storm durations. These toxicity results were based on tests with a range of hardness values from 21 mg/L to 359 mg/L as $CaCO_3$; however, hardness in most of the studies was less than 50 mg/L (similar to typical conditions in Puget Sound lowland streams during storm flow conditions).

The resulting median post-treatment pollutant concentrations in Table 4-8 are considerably less than the toxic thresholds presented for the two salmonid species in Table 4-9. The resulting pollutant concentrations are less than or approximately equal to the toxic thresholds for the two *Daphnia* species (presented as indicators of prey organisms).

Table 4-9. Copper and Zinc Toxicity Values for Chinook Salmon, Brook Trout, and *Daphnia* spp.

	LC50 Toxicity Value[a], Total Recoverable Metals	
Listed or Surrogate Species	**Copper, µg/L**	**Zinc, µg/L**
Chinook salmon	42	446
Brook Trout	110	2100
Daphnia magna	21	253
Daphnia pulex	25	356

Source: USEPA (1985, 1987)

[a] LC50 toxicity values are based on 96 hours of continuous exposure.

This analysis is, however, a coarse screening of the broad-scale biological effectiveness of the water quality treatment BMPs proposed in the Stormwater Management Program. Because these concentrations are based on median and average pollutant concentrations and removal efficiencies, some post-treatment pollutant concentrations will exceed toxic thresholds. In addition, some areas will have higher untreated pollutant concentrations or elevated background pollutant concentrations in the receiving waters and may require additional protection. As noted in the Stormwater Management Program technical standards, stormwater plans or studies will identify areas that would require increased treatment.

Treatment provided by the Stormwater Management Program will produce effluent with low TSS concentrations (Table 4-8). The predicted post-treatment median TSS concentration is 20 mg/L. Lloyd (1987) and Canada DFO (2000) report that adverse effects to fish are unlikely to occur at TSS concentrations less than 25 mg/L.

Additional Water Quality Issues

The following potential water quality issues are not directly addressed by the Model and may impact salmon and bull trout habitat. Except as discussed below, this biological review does not fully address these issues.

- As stated above, the 96-hour exposure toxicity thresholds are representative of storm durations. However, effects of repeated exposures or sublethal effects, not directly considered in the Model or in this biological review, may also be relevant to salmon and bull trout. Scientific literature is particularly lacking in conclusive research on these effects.
- Other pollutants found in stormwater are not fully addressed by this analysis or the Model. Stormwater treatment is typically aimed at conventional parameters such as sediment, metals, and oil and grease. Removal of metals is assumed to be indicative of prevention of acute toxicity, but other pollutants (organic compounds often not monitored or measured) may result in toxicity or sublethal effects. The effectiveness of stormwater BMPs in removing these pollutants is not well documented.
- Synergistic or antagonistic water quality effects are also not considered. It is possible that pollutants (including heat) may produce a more toxic effect. In many cases, however, dissolved organic carbon and other materials in the water column competitively bind metals, reducing or eliminating binding with fish gills (Paquin et al. 2000; Hollis et al. 1997; Meyer et al. 1999; Playle and Dixon 1993). In turn, this may reduce or eliminate toxicity, even when numerical water quality standards or toxicity thresholds such as those presented in Table 4-9 are exceeded.

Water quality treatment, as proposed in the Stormwater Management Program, is a sound technical concept for reducing the risk of acutely toxic conditions to chinook salmon, bull trout, and their prey. In

some cases, however, additional treatments (e.g., the enhanced treatment BMPs discussed above and/or regional water quality treatment BMPs) may be necessary and are included in the Model. Additional monitoring and studies are necessary to ensure that water quality treatment is sufficient to prevent sublethal water quality effects.

4.3.3 Regional Road Maintenance ESA Program Guidelines

The Regional Road Maintenance ESA Program Guidelines were evaluated in a separate biological review (Regional Road Maintenance ESA Forum 2002b). The Guidelines have been published in the Federal Register for public comment by NMFS under Limit 10 of the NMFS 4(d) Rule and submitted to USFWS for consideration and possible inclusion in a new special 4(d) rule for bull trout.

4.3.4 WRIA Based Planning Program

The guidelines established in the Model for WRIA based planning were guided by NMFS (1996). Ecosystem processes occur at spatial scales greater than individual jurisdictions and vary over time. The WRIA based planning framework attempts to reconcile ecosystem needs with jurisdictional constraints through a coordinated effort at the watershed scale. If implemented successfully, this program should yield benefits greater than those of isolated actions and is more multi-species in scope than individual jurisdictional programs or actions. It includes necessary mechanisms for addressing and prioritizing salmonid conservation issues, coordinating among stakeholders (the Services, state managers, Tribes, watershed groups, private citizens), developing watershed plans, implementing actions, restoring habitat, and utilizing adaptive management consistent with NMFS (1996). A system-wide planning effort such as the WRIA Based Planning Program would provide the scientific basis for the adaptive management programs that would lead to periodic refinements of land use policies and regulations as well as technical standards (Doppelt et al. 1993; National Research Council 1996).

Watershed based conservation planning is a theoretically sound and necessary component of effective implementation of the Model's WRIA Based Planning Program. It provides the mechanisms necessary to gather information, take action, and adapt to changing conditions over time in a broadly coordinated effort at the watershed scale. Effectiveness monitoring and reporting, and adaptive changes, would be necessary to ensure the performance of this program.

4.3.5 Habitat Acquisition and Restoration Funding Program

The Model states that habitat acquisition and funding are essential because policies, programs, and regulations can contribute to, but cannot fully accomplish, salmonid habitat protection. Improvement of previously degraded habitat, combined with protection of properly functioning habitat, are necessary for building a successful salmonid habitat protection program. No comprehensive long-term data are available to demonstrate the ecological value of funding habitat improvement and acquisition for salmonid conservation. However, it is a basic ecological principle that fish and other organisms require specific habitat characteristics in adequate amounts to carry out crucial biological functions necessary to sustain substantial populations.

Combined with other funding sources, the amount of money spent in the region under the Model programs would be substantial over the long term. Projections of available funding and its potential buying power (in terms of potential land acquisition and habitat improvement) are discussed in Chapter 6.

The funding program appears to have the proper safeguards for providing a dependable source of money and management mechanisms for the short term. These mechanisms include coordinating habitat improvement and acquisition through local watershed programs, monitoring program status, and reporting

the benefits of the efforts to the Services annually. There are also mechanisms in place to prevent inappropriate spending allocation; for example, the Model disallows the crediting of development project mitigation as a benefit.

The Habitat Acquisition and Restoration Funding Program does not provide specific habitat acquisition, protection, and improvement priorities and design principles. Watershed conservation plans, developed according to the Model, are expected to provide overall priorities and principles. The Stormwater Program also requires jurisdictions to develop fish-friendly ranking principles for capital improvement projects. Although the effects of proposed habitat funding and acquisition cannot be specifically analyzed until the conservation plans are completed for the Tri-County WRIAs, this program has the direct potential to maintain or improve salmon and bull trout habitat. The Habitat Acquisition and Restoration Funding Program is a sound and essential concept for salmonid conservation. The success of the program will, however, depend to some extent on the soundness of guidance provided by WRIA based planning.

4.3.6 Monitoring And Adaptive Management Program

The Monitoring and Adaptive Management Program is a key component for successfully implementing the Model. Adaptive management is an iterative learning process that is necessary and appropriate for refining management decisions (Lee 1999; Stankey and Shindler 1997). The process gives decision-makers the opportunity to undertake creative and innovative solutions. Provided the approach is sufficiently responsive to seize opportunities, the risks of undertaking these potential solutions in the absence of desirable levels of understanding is offset by the opportunity to learn and adapt the solutions to new information and understandings.

Adaptive management is appropriate for the Model efforts to address the 4(d) rule because of the uncertainty of the effectiveness of the Model programs in conserving salmonids. Habitat improvement or restoration is a relatively new science that retains substantial uncertainty, although freshwater habitats have been functionally maintained in many cases. Adaptive management is necessary because information on current habitat conditions and conservation options throughout Tri-County watersheds is just beginning to emerge and future changes to habitats and the associated science are inevitable.

Adaptive management can drive a regulatory program to become more liberal or more conservative; ideally these changes would occur dependent on the degree to which overall goals are being met. However, without specific guidance or limits, an adaptive management policy can be misapplied to further non-scientific agendas. The stated central purpose of the Monitoring and Adaptive Management Program is to protect and improve ecosystem functions and processes. A key principle of this program is that, in the absence of certainty, an environmentally protective approach should be taken. In the Model, the adaptive management function is integrated with WRIA based planning efforts. The state GMA program for "best available science" mandates the adaptive management approach in a situation where there is an absence of valid scientific information or incomplete scientific information (WAC 365-195-920(2)).

Adaptive management requires information as the basis for making rational decisions. The Model provides a long-term commitment to monitoring outcomes, evaluating successes and failures, and recommending appropriate revisions in the program elements. The approach for implementing adaptive management as defined in the Model requires accountability, commitment, and collaboration among jurisdictions, resource managers, and stakeholders. It includes necessary provisions for prioritization, taking environmentally protective approaches in the face of uncertainty, and acknowledges that management must be flexible to respond to the changing environment and best available science. However, while effectiveness and compliance monitoring are requirements that will be guided by appropriate technical staff and jurisdictional bodies that oversee funding, implementation, and analysis,

the Model does not specify who will provide that guidance. It is likely that monitoring requirements will vary among Model programs and among elements within the programs. Monitoring of habitat improvement and protection actions is necessary to provide the information needed for adaptive management decisions. Effective adaptive management may involve more formal specification of learning objectives than is commonly anticipated by proponents. Guidance providing uniformity in monitoring efforts would be appropriate.

The final step in adaptive management is effective dissemination of information together with a process for establishing shared understandings of the information acquired. Adaptive management may reveal the need to change institutional processes or structures affecting habitat conditions. Budgeting, agency coordination, and decision-making may need to change based on the results provided by adaptive management. The need to coordinate among stakeholders (the Services, state managers, Tribes, watershed groups, and private citizens) will require significant resources at all levels and sustaining management commitment and leadership over an extended period of time. (Duncan 2001; Stankey and Shindler 1997).

Adaptive management plans focus on a process to test the success of current programs and use this information to design and implement changes in the program identified as needed for success. This type of planning effort, as compared to prescriptive planning, involves a commitment of policy and scientific resources to monitoring, interpretation, and experimentation, which has not been characteristic of past programs. The Model, by requiring monitoring reports and modification of policies and technical standards on a 2-year cycle, would provide a more interactive and responsive program than the GMA requires in the 5-year comprehensive plan updates.

An adaptive management program will require institutional commitment and resources over a long period of time. Such an effort on the scale proposed involving multiple jurisdictions at the local, state, and federal level will be an essential element if the Model is to be successful. Monitoring and Adaptive Management Program needs for effective implementation are identified in Attachment I of the Model.

4.3.7 Summary of Evaluation of Technical Concepts

The Land Management, Stormwater Management, and Regional Road Maintenance Programs each include a number of elements that are based on general ecological concepts addressing habitat functions for salmon and bull trout. Our evaluation of the individual elements and the concepts upon which they are based indicates they are appropriately founded. Uncertainty regarding elements of each program occurs due to the imperfect state of knowledge regarding habitat functions and the requirements of chinook salmon and bull trout.

Founding the Model on appropriate technical concepts does not guarantee that Model programs will be implemented as intended. However, we expect that the foundation of Model programs, which is based on generally accepted ecological concepts, would support appropriate implementation of the Model and its individual programs.

The Model's basic intent is to address the need for preservation of existing habitat and provide an opportunity for habitat enhancement consistent with the WAC 365-195-925 provisions for best available science. The Model programs provide habitat protection measures to address stream flow, temperature, and other water quality attributes, as well as physical habitat characteristics.

Available evidence indicates the framework used to develop the Model is generally based on best available science. The Model appears to rely on appropriate assumptions supported by the information provided in the available literature. It also addresses specific policies and development regulations within the capacity of county and local jurisdictions to protect and enhance salmon and bull trout habitat. Model

standards were developed through three separate technical development and review processes: the Biological Review Committee, the Technical Work Groups, and the Negotiating Team. Development of the Model also included involvement of NMFS, the USFWS, and Tribal representatives. Representatives of these entities and the committees they served on are identified in Appendix C to Volume I of the Model (Tri-County 2001a).

The Land Management and Stormwater Management Programs provide procedures, but not criteria to evaluate variances and exemptions from the general provisions of the programs.

The Model's Monitoring and Adaptive Management Program, together with the WRIA Based Planning Program, provide procedures, but not specific criteria to develop and evaluate additional information to further develop best available science.

5. ANALYSIS OF MODEL EFFECTS ON SELECTED SUB-BASINS

Chapter 5 presents the sub-basin analysis methodologies, results, and conclusions. The six sub-basins selected for this analysis include Soos Creek, Newaukum Creek, Middle Green River, Longfellow Creek, Hamm Creek, and the Lower Duwamish River, all located within the Green River Watershed (WRIA 9; Figure 3-1). This chapter includes a full analysis of the Soos Creek sub-basin, and abbreviated analysis of the other five sub-basins (to avoid unnecessary repetition). Each of the six sub-basins would be affected by the same combination of the Tri-County Model 4(d) Rule Response Proposal (Model) programs, and each would be affected in a similar manner. Only a general description of baseline conditions and Model effects is provided for those sub-basins other than Soos Creek. The results for Hamm Creek are presented relative to those for Longfellow Creek because of the great similarity of their existing land use and habitat characteristics. Detailed descriptions of baseline conditions and Model effects for sub-basins other than Soos Creek are provided in Appendix L. In many cases, the Appendix L analyses refers back to the Soos Creek analysis in Chapter 5 to provide justification for the effects determinations. This chapter also discusses the applicability of the analysis to the greater Tri-County region.

Chapter 5 is organized as follows:

5.1 Sub-Basin Analysis Methodologies
- 5.1.1 Assumptions for Sub-Basin Analysis
- 5.1.2 Selection of Sub-Basins for Analysis
- 5.1.3 Determination of Sub-Basin Baseline Conditions
- 5.1.4 Determination of Program Effects in Sub-Basins

5.2 Results of Sub-Basin Analysis
- 5.2.1 Soos Creek (full analysis)
- 5.2.2 Newaukum Creek (conclusions discussed, full analysis in Appendix L)
- 5.2.3 Middle Green River (conclusions discussed, full analysis in Appendix L)
- 5.2.4 Longfellow Creek (conclusions discussed, full analysis in Appendix L)
- 5.2.5 Hamm Creek (conclusions discussed, no analysis in Appendix L)
- 5.2.6 Lower Duwamish River (conclusions discussed, full analysis in Appendix L)

5.3 Overall Sub-Basin Analysis Conclusions

5.4 Applicability of Sub-Basin Analyses to the Tri-County Area

This analysis of selected sub-basins within the Tri-County area was conducted to evaluate the likely effects of the Model on chinook salmon and bull trout habitat. It was intended to provide a means to determine if implementing the Model can be expected to generally maintain existing habitat conditions and opportunities for improved conditions, or make improvements in habitat conditions. The sub-basins selected represent a range of existing rural and urban development conditions. While populations of chinook salmon or bull trout are not known to occur in all of the selected sub-basins, the intent of this analysis was to evaluate changes in habitat conditions, rather than population metrics, within a range of development intensities and evaluate whether the Model would maintain, restore, or degrade properly functioning conditions (PFC) habitat indicators.

The evaluation compares baseline conditions to PFC as defined in the National Marine Fisheries Service (NMFS) and United States Fish and Wildlife Service (USFWS) Matrices of Pathways and Indicators (MPI)[24] for chinook salmon and bull trout habitat, respectively. The existing MPI criteria were defined for relatively high gradient forested streams in headwater areas. Currently, there is no widely accepted definition of PFC for estuaries, mainstem rivers, and lowland Puget Sound streams; therefore, existing MPIs were used because they represent the available guidance relied on by the NMFS and USFWS (Services) for making effects determinations.

This sub-basin analysis identifies the combinations of Model programs and program elements that would affect PFC habitat indicators, assuming that all Model programs were implemented within each sub-basin. The likely effects of the Land Management and Stormwater Management Programs are assessed in this biological review. The effects of the Regional Road Maintenance ESA Program Guidelines (Regional Road Maintenance ESA Forum 2002a) are assessed in an independent biological review (Regional Road Maintenance ESA Forum 2002b), with discussion of this program incorporated into the sub-basin analysis to evaluate the effects of implementing all Model programs. The potential role of the long-term action programs (Habitat Acquisition and Restoration Funding, Watershed Based Salmonid Conservation Planning [WRIA Based Planning], and Monitoring and Adaptive Management Programs) for achieving habitat improvements are considered for each sub-basin.

5.1 SUB-BASIN ANALYSIS METHODOLOGIES

The sub-basin analysis began with review of sub-basins throughout the Tri-Co area to identify those with appropriate existing information available for analysis.

5.1.1 Assumptions For Sub-Basin Analysis

Sub-basins within Watershed Resource Inventory Area (WRIA) 9, the Green River watershed, were selected for analysis because substantial data exists in a summarized form that was relatively consistent with the MPI criteria. Sub-basins were further selected within WRIA 9 to represent a broad range of land use conditions. No attempt was made to extrapolate the results of these sub-basin analyses to other sub-

[24] This matrix relies on the NMFS and USFWS MPIs for chinook salmon and bull trout, respectively, as the most appropriate published guidance accepted by the Services for evaluation of program effects. The MPIs are a coarse set of criteria, designed to be adapted as necessary to specific regions and species. The MPIs used for this analysis were developed for salmon and bull trout in higher-gradient headwater streams. Criteria include temperature, sediment, chemicals/nutrients, physical barriers, substrate, large woody debris, pool frequency, pool quality, off-channel habitat, refugia, width-to-depth ratio, streambank condition, floodplain connectivity, peak/base flows, drainage network, road density/location, disturbance history, and riparian reserves. PFC for Puget Sound lowland streams have not been defined. While the MPIs apply as a general guidance, specific indicators and thresholds may differ. The MPIs used in this biological review are assumed to be generally conservative with respect to the definition of PFC for lowland streams, because high-gradient headwater streams generally are colder, smaller, more dominated by riparian conditions, and less morphologically diverse than lowland streams. Therefore, in some cases in this analysis, baseline or restoration thresholds may indicate a more degraded condition than in fact exists. Because lowland conditions are not defined, it is also possible that more degradation may occur than indicated in this analysis depending on species and life history stage. In addition, other indicators of PFC or habitat impacts not included in the existing MPIs may be applicable to Puget Sound lowland streams or areas of urbanization. Examples of additional indicators include National Pollutant Discharge Elimination System (NPDES) permits, biotic integrity scores, and percentage total impervious area (TIA). However, criteria for these additional indicators are not yet fully developed and were not included in this analysis. Development of adequate criteria for such additional indicators, while useful, was beyond the scope of this biological review.

basins within the Tri-County region. Extrapolation was not tenable because sub-basin land use characteristics vary widely and effects of the Model regulations commonly depend on existing conditions. The nature of future development at all scales throughout the Tri-County area was not available to the authors. However, the potential effects of the Model on sub-basins of varying character and current land use characteristics in the Tri-County region are summarized and discussed at the end of this chapter (Section 5.4). This analysis assumes that the selected sub-basins are generally representative of the range of sub-basins in the Tri-County area, and that application of this analysis to other sub-basins depends on the similarity of land use designations and existing land use. According to the WRIA 9 Limiting Factors Analysis (LFA; King County and Washington State Conservation Commission [WSCC] 2000), either no sub-basin in WRIA 9 is considered properly functioning or else sufficient data was not available to make a determination of habitat conditions. Therefore, a properly functioning sub-basin is not represented by the sub-basin analysis in this biological review. The analysis also assumes that the Model would be applied uniformly over the sub-basin. Most land area (83%; Appendix C) in the Tri-County region is outside the urban growth area (UGA) and is largely comprised of designated forest production land (59.1% of the total Tri-County region) that would be subject to state or federal regulations rather than Tri-County Land Management regulations. Rural Land Management standards (i.e., Rural 65/10 Residential Site Standard and rural management zone [MZ] regulations) would apply to 23.9% of the total Tri-County region (designated agriculture and rural land combined outside of the UGA; see Appendix C) and urban land management standards (i.e., no 65/10 Residential Site Standard and urban MZ regulations) would apply to 17% of the total Tri-County region (total designated UGA).

Portions of this analysis (e.g., MZ analysis) focus on site- or reach-level effects influenced by the uncertainty of predicted spatial applications and effects at larger scales. Analysis results at the site or reach scale should be applicable to predicting site- and reach-level effects in reaches having similar levels of development and land use characteristics (e.g., percent forest cover).

The Land Management and Stormwater Management Programs would be implemented at the individual site scale. The Regional Road Maintenance and Habitat Acquisition and Restoration Funding Programs would occur at either site or reach scales. Implementation and effectiveness of the Model at larger scales (e.g., sub-basin or watershed) would rely on the Monitoring and Adaptive Management and WRIA Based Planning Programs to monitor, identify, prioritize, coordinate, and refine management activities. Shortfalls in achieving management objectives through the early-action programs are intended to be compensated for by habitat restoration activities/incentives, Capital Improvement Programs (CIPs), and habitat acquisitions.

This analysis uses the NMFS definition[25] for the terms restore, maintain, and degrade. The intent of the analysis is to predict how the Model would be expected to affect the habitat elements defined in the NMFS and USFWS MPIs. It assumes that if habitat improves, salmon and bull trout populations using this habitat will benefit. This analysis also assesses how the Model contributes to the conservation of salmonid habitat under varying levels of land development. The effects of the Model on salmonid population metrics are not evaluated.

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[25] NMFS (1996) defines these terms according to whether they are sufficient to move from one MPI category to another:

- *Restore*: means to move the baseline condition from one MPI category to another in a positive direction (not properly functioning to at risk, or at risk to properly functioning).
- *Maintain*: means to keep an indicator at its current baseline condition whether not properly functioning, at risk, or properly functioning.
- *Degrade*: means to move the baseline condition from one MPI category to another in a negative direction (properly functioning to at risk, or at risk, to not properly functioning).

5.1.2 Selection of Sub-basins for Analysis

The six sub-basins selected for this analysis include Soos Creek, Newaukum Creek, Middle Green River, Longfellow Creek, Hamm Creek, and the Lower Duwamish River, all located within the Green River Watershed (WRIA 9; Figure 3-1). Each sub-basin was selected based on the following considerations:

- Soos Creek represents a significant tributary system in which chinook salmon spawn. It has a mix of UGA and non-UGA designations, and it is an area where non-UGA development is primarily residential. Soos Creek represents an urbanizing sub-basin. Bull trout have been observed near the mouth of Soos Creek and may utilize areas of cold water refugia.
- Newaukum Creek represents non-UGA land in a primarily agricultural sub-basin. It provides spawning and rearing habitat for chinook salmon. In addition, bull trout have been observed near the confluence of Newaukum Creek and the Green River. Streams of similar character are also common in Pierce and Snohomish Counties.
- Hamm and Longfellow Creeks are small, low elevation sub-basins that are generally representative of small, heavily urbanized sub-basins. It is likely that neither creek ever supported significant spawning habitat for chinook salmon or bull trout. However, their lowest reaches and areas of confluence with the Lower Duwamish waterway are likely to have provided rearing habitat for juvenile chinook salmon and, to some extent, probably still do. These streams probably have not provided bull trout habitat, however, they do support other salmonid species (cutthroat trout and coho salmon) and are representative of many other highly urbanized small sub-basins within the Tri-County region that drain low elevation areas and discharge to lower rivers or Puget Sound. The primary difference between existing conditions in Hamm and Longfellow Creeks is that a greater percentage of Longfellow Creek is not contained within pipes.
- The Middle Green River sub-basin has a mixture of rural residential, public parkland, and agricultural land uses. The mainstem Middle Green River provides spawning, rearing, and foraging habitat for many salmonid species, including chinook salmon. Bull trout are also known to occur in the mainstem, at least up to river mile (RM) 64.5.
- The Lower Duwamish River is a large, urban and industrial, heavily modified lower-river estuarine system used by salmonids (including chinook salmon and bull trout) for migration, juvenile rearing, and foraging.

A more detailed description of sub-basin characteristics and baseline conditions is provided in the sub-basin sections of this chapter and in Appendix L.

5.1.3 Determination of Sub-Basin Baseline Conditions

Determinations of sub-basin baseline habitat conditions were based on conclusions or information contained in the WRIA 9 Limiting Factors Analysis[26] (King County and WSCC 2000). This information is a readily accessible, consolidated source of descriptions of existing habitat conditions that is largely consistent with the MPI.

Baseline conditions were established as properly functioning, at risk, or not properly functioning, as defined in the MPI for chinook salmon and bull trout, or by best professional judgement where adequate data were available to make a determination. MPIs were developed as guides to assess the effects of

[26] Habitat conditions in the WRIA 9 Limiting Factors Analysis were rated as good, fair and poor. These ratings were based on numerous criteria, including the MPI from NMFS (1996).

proposed actions on salmonid habitat at relatively small scales, though some indicators are measured at relatively large scales (e.g., disturbance history). The MPIs are based on the PFC concept, which is defined as the sustained presence of natural habitat-forming processes (e.g., hydraulic runoff, bedload transport, channel migration, vegetation succession, natural biological interactions, etc.) that are necessary for the long-term survival and recovery of a species (see Section 1.2.2). Thus, properly functioning habitat provides for the biological requirements of the species. PFC can vary from stream to stream, and criteria specified within the MPIs are not intended to be applied broadly to all systems (NMFS 1996). The absence of clearly defined PFC supported by scientific information for many habitat types makes assessment imprecise.

Though the MPI criteria may not be adequately defined for all stream types or geographical regions, the PFC pathways and indicators are included in the MPI because they cover a range of salmonid habitat considerations that should be taken into account when defining specific criteria. Habitat functions are frequently interrelated. Some of the main habitat relationships and functions of MPI indicators include the following:

- Temperature is a vital habitat requirement of salmonids. Temperature affects metabolic rates and oxygen concentrations. Different salmonid species and life stages have different ranges for temperature requirements.
- Sediment and substrate conditions affect the quality of spawning habitat, juvenile rearing habitat, and food resources.
- Chemical and nutrient contamination influences all aquatic life as it affects toxicity, oxygen concentrations, and stream productivity.
- Physical barriers impede habitat access required by anadromous and resident salmonid populations, which utilize different habitats during different life stages.
- Large woody debris creates pools, reduces width-to-depth ratios, provide physical cover for salmonids, improves substrate conditions, and increases nutrient retention important for overall stream production.
- Pools (i.e. pool frequency and quality) provide habitat required by juvenile and adult salmonids.
- Off-channel habitat provides rearing habitat for juvenile salmonids and serves as habitat refuge during high flow periods.
- Refugia of sufficient size and connectivity help maintain viable salmonid populations or sub-populations that can serve as sources of population expansion.
- Width-to-depth ratios can be indicators of proper stream function. Higher than expected width-to-depth ratios often indicate degraded conditions resulting from sedimentation or reduced base flows.
- Quality streambank conditions reduce erosion and provide cover for salmonids.
- Floodplain connectivity is characterized by hydrologically linked main channel and off-channel habitats. It allows for overbank flow that reduces stream erosive power and increases nutrient exchange with the landscape.
- Peak and base flows similar to natural conditions in magnitude and timing are critical for maintaining natural stream processes. Clearing, soil compaction, and impervious area increase the magnitude, duration, and frequency of peak flows. Reduced base flows increase width-to-depth ratios, reduce wetted area, and lead to increased stream temperatures.
- Increases in drainage network and road densities generally lead to altered flow regimes.

- Disturbance history indicates impacts to the landscape that could affect numerous habitat variables such as flow regimes and microclimate.
- Adequate riparian reserves support numerous riparian functions (including many other MPI indicators) as described in Section 4.3.1.1 such as channel migration, off-channel habitat, shading, microclimate, organic input, and large woody debris. The benefits of riparian buffers are reduced if peak and base flows are not similar to natural conditions.

The MPI is intended to be modified, where appropriate and where natural conditions dictate, to best define PFCs for different streams or different species' requirements (see footnote [1]). While the level of this sub-basin analysis is coarse, the results are discussed within the context of the variability of conditions and where MPI indicators may or may not be appropriate. When sufficient data were not available to definitively categorize a baseline condition according to the MPI, the baseline condition was assumed, based on available information and best professional judgment, or considered unknown and discussed within that context.

The NMFS 4(d) Rule for chinook salmon does not provide guidance for bull trout. The designation of critical habitat for listed species is required under Section 4(a)(3)(A) of the Endangered Species Act (ESA) and is generally determined at the time of the listing. However, the critical habitat designation for bull trout was deemed "not determinable" by USFWS (USFWS 1998) because of limited understanding of the habitat requirements of this species. As with chinook salmon, PFCs have not been developed for all habitats used by bull trout. However, spawning and rearing habitat conditions are relatively well known, resulting in the USFWS MPI for bull trout (USFWS 1998). PFCs for bull trout habitat are considered separately from chinook salmon because bull trout have more restrictive requirements, particularly for temperature (Berge and Mavros 2001). Bull trout also have a much different distribution throughout the Tri-County area than chinook salmon. Key characteristics of bull trout spawning and early rearing habitat are cold water temperatures and clean gravel, commonly found in pristine headwater streams of higher elevations. Although isolated cold water refuges supporting bull trout likely exist at lower elevations within the Tri-County area, they have yet to be demonstrated as habitat that support the full range of bull trout life stages. The migratory corridor and Puget Sound shoreline foraging requirements of bull trout appear to be less specific than those of chinook salmon and are not yet clearly defined.

5.1.4 Determination of Program Effects in Sub-Basins

The overall effects of the Model were determined for each sub-basin by considering the synergistic effects of the Model programs to predict whether the Model would be expected to maintain, restore, or degrade each PFC indicator, where applicable. Analyses of the Land Management (Appendix M), Stormwater Management (Appendix D), and the Biological Review of the Regional Road Maintenance ESA Program Guidelines[27] (Regional Road Maintenance ESA Forum 2002b) were used for this determination. The role and effects of the Habitat Acquisition and Restoration Funding, WRIA Based Planning, and Monitoring and Adaptive Management Programs were also generally considered when making effects determinations. The methodology and results of analysis of the MZ regulations contained within the Land Management Program are described in detail in Appendix M. Analysis of the Rural 65/10 Residential Site Standard, a major element for applying the Stormwater Management Program to rural areas, is analyzed in detail in Appendix B. For the sub-basin analysis, the combined effects of the

[27] The Regional Road Maintenance ESA Program Guidelines and Biological Review are included on compact disk in the back cover of this document.

Model programs were determined to predict whether the Model would maintain, restore, or degrade each PFC indicator (see Section 3.1).

5.2 RESULTS OF SUB-BASIN ANALYSES

This section presents a detailed analysis of the Soos Creek sub-basin. A general description of sub-basin characteristics, baseline conditions, and Model effects is also provided for each of the other sub-basins.

5.2.1 Soos Creek

The Soos Creek sub-basin has a drainage area of approximately 44,800 acres and contains about 60 miles of streams (King County and WSCC 2000). Major streams within the sub-basin include Big Soos, Little Soos, Soosette, Covington, and Jenkins Creeks. There are numerous smaller streams within the sub-basin as well, and three distinct stream morphologies. The headwaters are a mix of low-gradient (< 0.1%) riffles and swampy, mud-bottomed channels that flow through extensive wetland complexes. From RM 4.75 to RM 2, Soos Creek is a 1.4% gradient reach of long riffles and pools flowing through a steep-sided ravine as it descends from the plateau, where it originates, down to the Green River valley floor and floodplain. Below RM 2, the gradient decreases to 0.5%, and Soos Creek becomes a floodplain channel type.

Although much of the Soos Creek sub-basin remains rural, residential and commercial development is widespread. Areas of concentrated development include the north and west portions of the sub-basin west of Big Soos, along and east side of Little Soos near the confluence with Big Soos, and in residential communities around several lakes. Jenkins and Covington Creeks mainly contain rural residences and hobby farms, although portions of Jenkins Creek flow through developed areas. Soos Creek, below the confluence of Big Soos and Little Soos Creeks, as well as upper Little Soos Creek, is largely undeveloped. About 48% of the sub-basin is designated UGA (Appendix C)[28], and those areas of the heaviest existing development are primarily contained within the UGA (King County and WSCC 2000). As a result of development patterns and the effects of impervious surface on infiltration rates, peak flows are higher in the more densely developed areas of the Soos Creek sub-basin, while base flows are lower.

Chinook salmon spawn primarily in the Soos Creek mainstem, below RM 6, and in lower Covington and Jenkins Creeks. There is also sporadic chinook spawning in lower Little Soos and Soosette Creeks. Bull trout are not known to occur in the Soos Creek sub-basin other than in the very lower reaches near the confluence with the Green River, where they have been documented in recent years. However, bull trout may use the watershed during the summer for foraging or seeking thermal refuge in cold water springs where they occur.

While largely rural, the Soos Creek sub-basin is rapidly developing and is expected to see increasing residential and minor commercial development within the UGA and rural residential development outside the UGA (King County and WSCC 2000). Residential use dominates the Soos Creek sub-basin, accounting for 40% of existing use and 80% of the designated use. Existing forest, primarily early to mid-successional deciduous and mix-forest types, accounts for approximately 26% of the sub-basin; scrub/shrub land covers another 10%.

[28] For the purposes of this analysis, the Soos Creek sub-basin includes the Soos Creek, Jenkins Creek, and Covington Creek sub-basins defined in Appendix C. Therefore, the values of land use designations and existing use described in the text combine the values for these three sub-basins (e.g., 48% UGA described in text is the total percentage of UGA area for the Soos Creek, Jenkins Creek, and Covington Creek sub-basins combined).

Chinook, coho, pink, and chum salmon, cutthroat trout, and winter steelhead naturally spawn in the Soos Creek sub-basin. In addition, the Soos Creek State Fish Hatchery at RM 0.7 has been in operation since 1901 and currently produces substantial runs of chinook and coho salmon. A single bull trout was reportedly captured at the hatchery in 1956, but no known bull trout population currently exists in the Soos Creek sub-basin (King County and WSCC 2000); however, additional sightings of bull trout have been observed near the mouth of Soos Creek in recent years.

5.2.1.1 Soos Creek: MPI Baseline Conditions and Model Effects

Current baseline conditions in the Soos Creek sub-basin are indicative of an actively urbanizing area. Selected baseline conditions of the sub-basin and the predicted effects of the Model are summarized in Table 5-1 and discussed below. Approximately 48% of the Soos Creek sub-basin is UGA and would receive the less restrictive urban MZ standard. The remaining 52% of the sub-basin and much of the chinook habitat is outside the UGA and would receive the more restrictive rural MZ standard. The following effects determinations assume application of the urban standard MZ in the UGA and the rural MZ standard in the non-UGA. Further discussion of the differences between the riparian protection provided by these standards is included in Appendix M.

The combined effects of the Model would be expected to maintain salmonid habitat indicators in the Soos Creek sub-basin in the short term (at levels ranging from not properly functioning to properly functioning; Table 5-1). The combined effects of the Model would also be expected to maintain or restore salmonid habitat indicators in the long term (at levels ranging from not properly functioning to properly functioning), based on the analysis of specific indicators discussed below. The level to which indicators are maintained or restored is relative to the baseline condition. Restoration of habitat indicators from one baseline condition to the next in the long term (e.g., restoring large woody debris from not properly functioning to at risk) assumes an accumulation of habitat benefits through maturation of riparian vegetation and implementation of habitat restoration projects over the 100-year time frame. The individual effects of Model programs are further presented in Chapter 6.

Table 5-1. Soos Creek Sub-basin Baseline Conditions and Predicted Effects of the Model

Pathways[a]	Indicators	Baseline Condition	Predicted Model Effect Short Term (5 – 20 years)	Predicted Model Effect Long Term[b] (50 – 100 years)
Water Quality	Temperature	NPF chin NPF bull	maintain NPF chin maintain NPF bull	maintain NPF chin maintain NPF bull
	Sediment (fines/turbidity)	AR chin and bull	maintain AR chin and bull	either maintain AR or restore PF chin and bull
	Chemicals/Nutrients	AR chin and bull	maintain AR chin and bull	maintain AR chin and bull
Habitat Access	Physical Barriers	AR chin and bull	restore PF chin and bull	restore PF chin and bull
Habitat Elements	Substrate	AR chin and bull	maintain AR chin and bull	either maintain AR or restore PF chin and bull
	Large Woody Debris	NPF chin and bull	maintain NPF chin and bull	restore AR chin and bull
	Pool Frequency	NPF chin and bull	maintain NPF chin and bull	either maintain NPF or restore AR chin and bull
	Pool Quality	NPF chin and bull	maintain NPF chin and bull	either maintain NPF or restore AR chin and bull
	Off-Channel Habitat	NPF chin and bull	maintain NPF chin and bull	either maintain NPF or restore AR chin and bull
	Refugia	AR chin and bull	maintain AR chin and bull	maintain AR chin and bull
Channel Condition & Dynamics	Width/Depth Ratio	NPF chin and bull	maintain NPF chin and bull	either maintain NPF or restore AR chin and bull
	Streambank Condition	AR chin and bull	maintain AR chin and bull	either maintain AR or restore PF chin and bull
	Floodplain Connectivity	AR chin and bull	maintain AR chin and bull	maintain AR chin and bull
Flow/Hydrology	Peak Flows	NPF chin and bull	maintain NPF chin and bull	either maintain NPF or restore AR chin and bull
	Base Flows	NPF chin and bull	maintain NPF chin and bull	maintain NPF chin and bull
	Drainage Network	NPF chin and bull	maintain NPF chin and bull	maintain NPF chin and bull
Watershed Condition	Road Density/Location	NPF chin and bull	maintain NPF chin and bull	maintain NPF chin and bull
	Disturbance History	NPF chin and bull	maintain NPF chin and bull	maintain NPF chin and bull
	Riparian Reserves	NPF chin and bull	maintain NPF chin and bull	either maintain NPF or restore AR chin and bull

a Other pathways and indicators are applicable and more pertinent to urban or Puget Sound lowland streams and should be taken into account by jurisdictions seeking a take limit. Examples of other pathways and indicators include index of biological integrity (B-IBI) biotic index scores, NPDES permits, percent forested in the basin, and percent TIA. Additional matrices that incorporate these additional indicators of properly functioning streams are currently being developed by the NMFS. Additional bull trout indicators such as sub-population size, growth and survival, life history/diversity, genetic integrity, and integration of species, and habitat conditions are not applicable to Soos Creek because there are no known bull trout populations. The Riparian Conservation Area indicator is NPF for bull trout because there are none. Soos Creek does not fall within the range of criteria for the disturbance regime indicator. However, the inapplicability of population indicators does not negate the predicted effects on stream habitat that the Model addresses.

b While Model regulations would improve conditions, restoration of habitat indicators in the long term would be largely be dependent on the extent of habitat restoration and habitat acquisition. The rural MZ standard does have the potential to support properly functioning conditions, but the urban standard does not – particularly with respect to large woody debris recruitment and those habitat indicators that are greatly influenced by woody debris.

NPF = not properly functioning | **AR = at risk** | **chin = chinook salmon**
PF = properly functioning | bull = bull trout | Water Temperature

Baseline: Water temperature is considered not properly functioning for chinook salmon in the Soos Creek sub-basin. This is based on frequent exceedances of spawning and rearing maximum and 7-day moving average temperature standards for chinook salmon (class A = 18°C, rearing = 17.5°C, spawning = 14.5°C) by 1 to 6°C for all major tributaries within the sub-basin (King Co. and WSCC 2000). Bull trout require even lower temperatures (rearing standard = 4 to 12°C, spawning standard = 4 to 9°C) and, therefore, temperature is not properly functioning in Soos Creek for bull trout functions. Bull trout may, however, use portions of Soos Creek for foraging or may seek thermal refugia in localized areas of cold water, where water temperature may be properly functioning. Declining base flows (from increased water withdrawals and loss of groundwater recharge), and loss of riparian vegetation associated with increased urbanization and development activities, has contributed to an upward trend in water temperatures over the last 20 years (King County and WSCC 2000).

While water temperatures in the Soos Creek sub-basin are likely greater than under natural conditions, temperatures are currently within the range of natural variability of some salmonid streams. Under natural conditions, temperatures in many salmonid streams vary widely from near freezing in winter to as high as the low 20s°C in late summer. However, temperatures generally fall within the life stage tolerances of salmonids during that period of the year when the specific life stages are expected to be present, particularly for fall (ocean-type) chinook salmon. Spring chinook (river-type) salmon are reported sporadically in Soos Creek, where they inhabit freshwater throughout summer and are subjected to elevated temperatures (King County 1989). Water temperatures in the Soos Creek sub-basin also are not suitable for bull trout during summer periods.

The potential effects of elevated temperatures range from lethal effects at temperature extremes, to sublethal effects at more moderate temperatures. Lethal effects are typically measured as the period of time producing mortality of a specified portion of the population (10 or 50%) for a specific temperature (Brett 1952). Sullivan et al. (2000) used laboratory data on mortality from the literature to demonstrate that lengthy exposure periods of many days are required to cause 10% mortality in juvenile salmonids when temperatures are in the low 20s°C. Although Soos Creek temperatures frequently exceed chinook salmon spawning and rearing standards, temperatures only occasionally exceed 20°C, and direct mortality to rearing juveniles would not be likely. Generally, higher water temperatures occur in late summer, outside the spawning period, when few or no juveniles are present. Higher temperatures could, however, block the migration of returning adults throughout the early portion of the spawning period during some years.

Growth has been found to be a reliable measure of sublethal effects of elevated water temperatures (Brett 1971, 1995; Iverson 1972). Growth rate is moderated by temperature and food consumption (Brett et al. 1971, 1982) and Sullivan et al. (2000) demonstrated that near maximum growth takes place over a wide range of temperatures that occur naturally in streams, assuming adequate food availability. Growth analysis suggests that an upper threshold for the 7-day mean temperature of 14.8°C for coho and 17.0°C for steelhead will maintain growth within 10% of optimum, and 19°C will maintain growth within 20% of optimum. In general, temperatures 18°C or below are not likely to produce a detrimental influence on growth. Given the range of factors influencing growth, a wide range of water temperatures are suitable for rearing salmonids, and temperatures in the Soos Creek sub-basin do not likely cause detectable sublethal effects. While there is the potential for sublethal effects, they are difficult to measure given the multitude of other variables affecting fish condition.

Increases in water temperature contribute to lower dissolved oxygen (DO) potential, which is a possible limiting factor in salmonid production. Concentrations of DO are frequently below incubation standards (10.5mg/L) during defined salmonid incubation periods and below Class A and rearing standards (8

mg/L) during rearing periods. Increases in water temperature are likely to be caused by decreased shading and loss of stream base flows through groundwater withdrawals and reduced infiltration rates.

Effects: Water temperature is expected to be maintained as not properly functioning in the short and long term for chinook salmon. Temperatures for bull trout would also be maintained as not properly functioning in the short and long term due to the following program effects[29]:

- MZ regulations would be expected to generally maintain current buffer conditions in the short term. MZ regulations have the potential to improve water temperatures in the long term, through the protection and eventual maturation of substantial existing immature riparian forest (see Appendix M for MZ analysis). Mature coniferous and deciduous riparian buffer would provide greater temperature control via shading than a buffer comprised of immature vegetation (May 2000).
- Habitat enhancement funding would be expected to maintain and potentially incrementally improve riparian conditions, which would improve vegetation and shading on a sub-basin scale in the long term[30].
- As discussed in Appendix B, the Rural 65/10 Residential Site Standard would limit new effective impervious area and minimize the loss of forest cover in the rural portions of the Soos Creek sub-basin. This would retain pervious areas and reduce effects of development on base flows. However, the Rural 65/10 Residential Site Standard would not apply to the urban portions of the Soos Creek sub-basin.
- As discussed in Section 4.3.2.1, full dispersion of runoff, soil amendments, infiltration/dispersion BMPs, and infiltration facilities would be expected to reduce loss of infiltration and groundwater input to Soos Creek and its tributaries. The effectiveness of these actions on a sub-basin scale is uncertain.

Sediment

Baseline: The sediment indicator of the MPIs is a combination of percentage of fines in gravel and turbidity. Stream substrate with less than 12% fines in the gravel and low turbidity in the water column is considered PFC. In this analysis, sediment was assumed to be at risk based on the at risk determination for fines in gravel. Turbidity was considered properly functioning. No data were presented in the WRIA 9 LFA (King County and WSCC 2000) on percentage of fines in gravel to definitively rate it as an indicator. We assumed the sediment indicator to be at risk for chinook salmon and bull trout in this analysis based on reported increased sediment yields, areas of erosion, and an overall rating of "fair" in LFA (King Co. and WSCC 2000). Though turbidity data were lacking, turbidity is assumed to be properly functioning for chinook salmon and bull trout in this analysis based on occasional observations of elevated turbidity near the Soos Creek Hatchery (King County and WSCC 2000), and the literature discussed below regarding potential turbidity tolerances. Total suspended solids (TSS) have been monitored more frequently and indicate that levels may occasionally exceed standards for sublethal effects, depending on the duration of the events (King CO. AND WSCC 2000).

The roles of turbidity and suspended sediments in biological processes involving salmonids are similar. Frequently, the two terms are used jointly without distinction for the true technical differences. Turbidity

[29] The Model does not address surface and groundwater withdrawals for water supply because the authority of local jurisdictions to address water supply varies widely. It is assumed that water supply authorities will take appropriate steps to ensure their water withdrawals are ESA-compliant.

[30] Habitat Acquisition and Restoration Funding Program would fund both riparian enhancement projects on public and private property (i.e., conservation easements).

refers to the attenuation of light in water, while suspended sediment refers to the suspension of mineral and organic particles within the water column. Turbidity is a natural part of the habitat to which young salmonids have adapted in some systems over prolonged periods.

Some chinook salmon stocks and coho, chum, and sockeye salmon populations are produced in extremely turbid river systems and estuaries such as the White River of the Puyallup River system and the Taku River in southeastern Alaska. In the Taku River, estuarine turbidities are commonly 400 nephalometric turbidity unit (NTU; Murphy et al. 1989). While Green River salmonid stocks are not necessarily adapted to similar turbidity conditions, we have found no data indicating that turbidity tolerance varies substantially among local stocks of salmonids or that turbidities in excess of those observed in Soos Creek would be detrimental to the populations. However, some literature suggests differences in the effects of turbidity and suspended sediments based on characteristics of the suspended sediment. For example, the absence of direct mortality in glacier-fed streams may be explained by smaller particle size of glacial silt (Newcombe and Jensen 1996). In addition, suspended sediment originating from urban landscapes would contain higher levels of contaminants than from more natural landscapes. Turbidity can have sublethal effects that are both positive and negative. Turbidities up to 108 NTU, such as occur in the Fraser River (Gregory and Levings 1998), can reduce predation of young chinook and other salmon. High turbidity can also reduce feeding by young salmonids. Gregory and Northcote (1993) observed the highest feeding rates at intermediate turbidity levels (35 to 150 NTU). Gregory (1994) reported that young chinook salmon had reduced foraging rates in turbidity above 150 NTU, but continued to feed at turbidities as high as 850 NTU. In addition, young salmon and bull trout may avoid increased turbidity when lower turbidity water is available, or become more active at moderate levels of turbidity (Bisson and Bilby 1982). High concentrations of suspended sediment may delay or divert spawning, and extremely high concentrations can cause spawning salmon to avoid an area (Spence et al. 1996).

Effects: Sediment is expected to be maintained as at risk for fines in the short and long term and potentially restored to at risk in the long-term for chinook salmon and bull trout due to the combination of Model programs and programs elements listed in Table 5-2. Fines in gravel would improve over time to the extent that riparian functions are improved and habitat restoration activities are implemented. Turbidity is currently estimated to be properly functioning and would not likely increase as riparian vegetation matures or improved stormwater facilities come into operation. In addition,

Chemicals and Nutrients

Baseline: Chemicals and nutrients are considered to be at risk for chinook salmon and bull trout. This is based on an overall “good” rating for water quality in the WRIA 9 LFA (King Co. and WSCC 2000), but reported decreases in Soos Creek State Fish Hatchery production have been attributed to reduced water quality (King County 1989, but specific water quality parameters were unspecified in the document). There is substantial potential for non-point source pollution originating from developed areas (lawns, roads, commercial/industrial lands, etc.) within the sub-basin and shallow groundwater areas along stream reaches.

Table 5-2 Combinations of Model Programs and Program Elements Affecting Sediment, Substrate, Pool Frequency, Pool Quality, Width-to-Depth Ratio, Streambank Condition, and Peak/Base Flow MPI Habitat Indicators.[a]

- As discussed in Section 4.3.2.1 and 4.3.2.2, the combined effects of the Rural 65/10 Residential Site Standard, full dispersion of runoff, soil amendments, infiltration/dispersion BMPs, and infiltration facilities would be expected to reduce loss of infiltration (thus reducing increases in surface runoff). However, the effectiveness of these actions on a sub-basin scale is uncertain.
- Flow duration controls would be expected to prevent increases in peak flows and the duration of erosive flows[b]. Furthermore, The Model requires that facilities be designed to match the discharge durations for the site condition that existed prior to any development in the Puget Sound region. Without information regarding the original site condition, the predevelopment condition must be assumed to be forested. Because the undeveloped portions of the Soos Creek sub-basin have only 31% forest, matching flows to forested conditions would restore peak flows.
- Water quality treatment, applied to new development, would be expected to maintain sediment levels (see Section 4.3.2.7).
- Fish habitat ranking, habitat funding for enhancements and acquisitions, and watershed assessment and salmon conservation planning would be expected to locally improve habitat (based on observation of recent funding and building of habitat enhancement projects in the region). Habitat enhancements would be expected to maintain and incrementally improve banks and channels, resulting in sub-basin-scale improvements in the long term if flow conditions are also improved (see the first bullet above). However, it is impossible to determine the extent and certainty of such activities because such prioritization and enhancements are not identified.
- Road maintenance BMPs designed to control sediment runoff from work areas would be expected to maintain sediment and turbidity in the short time frame (Regional Road Maintenance ESA Forum 2002b).
- Design, construction, and maintenance of stormwater and right-of-way structures through the Stormwater Management Program and Regional Road Maintenance ESA Program Guidelines will maintain or restore flow velocities and volumes by requiring appropriate drainage system design, system replacement, appropriate maintenance, and removal of sediments or blockages.
- Road maintenance BMPs (Regional Road Maintenance ESA Forum 2002a) designed to directly improve riparian conditions or stream habitat (e.g., large woody debris, streambed gravel) would be expected to have site-specific positive effects in the short term. The addition of streambed gravel and large woody debris through road maintenance BMPs would be expected to have short-term localized positive effects on substrate. Other road maintenance BMPs (example: re-vegetation techniques) that contribute to riparian vegetation may have overall positive long-term regional effects as the BMPs are broadly applied and vegetation matures, but the extent and magnitude is unknown.
- Management zones would be expected to protect existing riparian forest. In the long-term, existing buffer vegetation would be expected to mature and approach a more natural condition. At the local scale, in areas where stream banks are unstable, allowing trees to mature would serve to stabilize them. Where banks are stable, and young trees are present in the riparian zone, maturing trees will help maintain streambank stability (maintaining an existing condition) and reduce channel erosion and sediment and turbidity, if flow conditions are also improved (see the first bullet above). However, MZs would have no effect on unstable streambanks at sites that are already developed.
- Temporary erosion and sedimentation controls (TESC) would be expected to reduce in-stream sedimentation relative to existing conditions (thus improving gravel and pools) and improve water quality. Sediment loads from construction activity are projected to be reduced from current levels because the proposed TESC BMPs are improved over historic practices, and several new BMPs have been added, including seasonal work limitations and clearing limits; these are not practiced in most jurisdictions within the Tri-County area at this time. Furthermore, more stringent construction site thresholds will require formal TESC for more sites. Currently, only projects greater than 5 acres are permitted under NPDES. That threshold will be reduced to 1 acre under NPDES Phase II. The new Ecology Manual requires local jurisdictions to permit construction sites having new impervious surfaces of 2,000 square ft or greater, whereas the current trigger is 5,000 square ft and single family homes are exempted. Most construction projects will be covered under the new requirements. The above improvements would be expected to appreciably improve erosion and sediment control on a sub-basin scale, but there remains uncertainty with regard to control of very fine sediment (and turbidity). BMPs sized for the 2-year flow will capture the majority of sediment, but would not control very fine sediment particles and turbidity (Ecology 2001). Advanced treatment is often necessary, particularly for wet season construction. Although advanced treatment is an option, there is no assurance that it will be required or used on an effective basis; the primary impact continuing to occur would be degradation of water quality, specifically turbidity.

[a] The rationale for determinations of effects on these PFC indicators of sediment, substrate, pool frequency, pool quality, width-to-depth ratio, streambank condition, and peak/base flow are based on similar combinations of the Model programs and program elements as they affect channel condition, sedimentation, and flow regimes. Effects determinations for these indicators in other sub-basin analyses (Appendix L) frequently reference back to the rationales presented in this table.

[b] The flow duration standard is applied for flows occurring between a lower threshold of 50% of the 2-year natural discharge rate (½Q2) and an upper threshold of the full 50-year flow rate (Q50). The ½Q2 flow rate is generally estimated to be the lower threshold of bed material mobilization (King County 1998). Booth (1993) reviewed several studies demonstrating that the lower threshold of bedload movement is approximately at or near this level. Because Booth's findings were imprecise, this means that some undetained flows less than ½Q2 may or may not be erosive. The upper threshold of the flow control standard is set at Q50. Flows in excess of Q50 occur infrequently (approximately several tens of hours over a 100-year period). Flows in excess of Q50 will be extreme events in which a substantial amount of flows would be out-of-bank, thus not doing "work" in the channel. For these reasons, increases in flow durations for flows in excess of Q50 would not be expected to exert a significant effect on maintaining or restoring PFC. Although the ½Q2 and Q50 thresholds appear to be reasonably conservative, they have not been empirically evaluated to sufficiently determine their performance. Monitoring is needed to confirm these thresholds, but the model does not provide a detailed monitoring program.

Effects: Chemicals and nutrients are expected to be maintained as at risk in the long and short term for chinook salmon and bull trout based on the following program elements:

- As discussed in Section 4.3.2.7, water quality treatment would be expected to control metals to less than acute toxic thresholds. The goal of basic water quality treatment BMPs in the Stormwater Management Program is to reduce pollutants to the maximum extent practicable to be consistent with the Clean Water Act (CWA) as applied to stormwater. If state water quality standards are not being met within urbanized and urbanizing sub-basins, stormwater plans are expected to improve upon this basic level of treatment by identifying practicable improvements or other actions for further reducing pollutants.
- Source controls would be expected to reduce localized sources of pollutants (for existing commercial, multi-family, industrial, and government facilities), or prevent appreciable increases in such sources (for new facilities). However, because non-point sources are assumed to be the greater source, the effects of this element would be expected to be limited. Increased awareness through public education (as proposed by the public education element of the Stormwater Management Program) about the harmful effects of certain practices and behaviors would be beneficial in reducing non-point sources.
- As discussed in Appendix B, the Rural 65/10 Residential Site Standard is projected to minimize the loss of forest cover. However, because the sub-basin is currently less than 65% forested, the 65/10 Standard would not attain the NMFS goal of 65% over the entire sub-basin. By minimizing conversion of forest cover to non-native vegetation, this standard would be expected to limit the amount of new area of managed vegetation in which fertilizers and landscaping chemicals are applied.
- Road maintenance BMPs designed to control sediment runoff from work sites would also be expected to partially control chemical runoff and contribute to maintaining existing conditions affected by road maintenance practices.
- As stated above, improved TESC practices would be expected to reduce current levels of sediment loads from construction. As a result, nutrients bound in sediment would be reduced from current levels. Construction BMPs include control of other pollutants as well, and, therefore, would be expected to control chemical runoff from construction sites.
- More frequent inspection of public and private facilities, as well as enforcement of minimum maintenance standards, would improve facility efffectiveness and also reduce sediment.

Physical Barriers

Baseline: The physical barriers indictor is considered to be at risk for the Soos Creek sub-basin. A number of culvert barriers exist at road crossings on small tributary streams, however, there are no natural or man-made physical migration barriers that would impede movement of naturally-reared salmonids on the mainstems of the major tributaries (King County and WSCC 2000) where most chinook salmon spawn. When the Soos Creek State Fish Hatchery is in operation from mid-August to the third week of November, hatchery weirs present a barrier to upstream migrating adults. Naturally reared adults are passed after they are separated from the hatchery fish, which are retained. When the weirs are not in place, anadromous salmonids can move freely upstream without delay. Although the fish weir barriers are managed properly, they still constitute a migration delay. Hatchery operations, including weir operations, are beyond the control of local jurisdictions and, therefore are not addressed by the Model or evaluated in this biological review.

Effects: The physical barrier indicator is expected to be restored to properly functioning in the short and long term for chinook salmon and bull trout due to implementation of the program elements discussed

below (furthermore, culverts that impede anadromous fish passage are currently being replaced as part of programs that are outside the scope of the Model):

- Regular inspection of public culverts (by the jurisdiction owning the culvert through either the Stormwater Management or Regional Road Maintenance Programs) would be expected to identify and lead to the repair of fish passage blockages and would proactively identify culverts needing replacement.
- Priority ranking and funding of stormwater mitigation CIPs and fish habitat projects, although not clearly defined, would be expected to contribute to maintaining and possibly improving salmonid habitat priorities over current priorities. Fish-friendly design principles prohibit additional barrier-forming culverts. Continuation of this policy would be expected to maintain conditions, and any mitigation funding would be expected to remove culvert blockages.[31]
- Because fish passage conditions are currently generally properly functioning on larger tributaries, habitat funding is not needed for widespread improvements, except in smaller tributaries. Funding at or near current levels would be expected to be sufficient to maintain or improve these conditions.

Substrate

Baseline: Substrate in the upper reaches of the Soos Creek sub-basin tributaries is characterized by sections of good gravel and naturally alternating braided swampy channels having mud bottoms. Substrate in floodplain channel segments is predominantly gravel (70 to 80%). Substrate condition is undefined, but is assumed to be at risk for chinook salmon and bull trout for the purposes of this analysis based on known problem areas of erosion and increased sediment yields and an overall "fair" rating for substrate in the WRIA 9 LFA (King County and WSCC 2000).

Effects: The substrate indicator is expected to be maintained as at risk in the short term, and either maintained as at risk or restored to properly functioning for chinook salmon and bull trout in the long term. Table 5-2 provides the combination of programs and program elements that would function to prevent sediment delivery to streams.

Large Woody Debris

Baseline: Large woody debris is considered not properly functioning for chinook salmon and bull trout in the Soos Creek sub-basin. Although no quantitative large woody debris surveys have been conducted, large woody debris is reported to be moderate, but insufficient (King County and WSCC 2000). One indicator of insufficient large woody debris is the prevalence of riffle habitat—as large woody debris decreases, riffle habitat tends to increase (King County and WSCC 2000). Furthermore, recruitment potential is currently limited by a lack of mature riparian vegetation. Maturation of existing riparian vegetation would increase quantity and quality of large woody debris available for recruitment (May 2000).

Effects: Large woody debris was predicted to be maintained as not properly functioning in the short term and restored to at risk in the long term for chinook salmon and bull trout in the Soos Creek sub-basin based on the combined effects of the following program elements:

[31] Typically, culverts and fish passage issues are described in terms of adults migrating upstream to natal spawning grounds. What is often overlooked is that culverts, even if properly installed for this purpose, can be undersized and result in hydrologic blockages to juvenile upstream migration for rearing. The program language should be improved to expressly consider juvenile fish passage in addition to adult fish passage.

- The Regional Road Maintenance ESA Program large woody debris BMPs would, at best, maintain large woody debris in the short term by incorporating large wood in bank revetment projects, but this would not improve recruitment sources on a sub-basin scale.
- Habitat enhancements and acquisitions would be expected to locally improve amounts of large woody debris and buffers in the short term. However, habitat enhancements would rely on MZ regulations to protect and establish a sustainable source of long-term large woody debris recruitment.
- MZs would be expected to maintain or improve the potential for large woody debris recruitment and provide recruitment sources in the long term through protection of existing mature riparian forest, maturation of immature riparian forest, and reforestation of currently cleared but undeveloped land (Appendix M). Additionally, mitigation requirements on development permits issued in accordance with the MZ requirements would contribute to recruitment of large woody debris at development sites.

Though properly functioning large woody debris is not predicted in this analysis, the rural MZ standard could potentially support properly functioning large woody debris, whereas the urban MZ standard could not. However, both standards may have the potential to improve conditions. Accordingly, the rural standard has the potential to support properly functioning habitat indicators that rely on large woody debris recruitment (e.g., pool frequency, pool quality, off-channel habitat, refugia, width-to-depth ratio, and floodplain connectivity), whereas the urban standard could not. In addition, the extent to which riparian habitat functions improve would be dependent on the extent of existing riparian buffer vegetation.

Pool Frequency

Baseline: The WRIA 9 LFA (King County and WSCC 2000) did not identify existing pool frequencies in Soos Creek, but did describe existing pool to riffle ratios (Table 5-3).

Table 5-3. Pool to Riffle Ratios in the Soos Creek Sub-basin (King County and WSCC 2000)

Stream Name	Upper Reaches	Lower Reaches
Little Soos Creek	20:80	50:50
Big Soos Creek	30:70	20:80
Covington Creek	90:10	5:95
Jenkins Creek	90:10	10:90

While 50:50 pool to riffle ratios are often considered ideal (King County and WSCC 2000), properly functioning pool to riffle ratios vary depending on the channel type of each stream or reach. Much of the upper Soos Creek sub-basin contains low gradient reaches with little erosive power, which is typical of palustrine channel-types where pools can be expected to be more prevalent (e.g., upper Covington and Jenkins Creeks). Though the pool to riffle ratios in Table 5-3 are within natural ranges, pool frequency is likely not properly functioning for chinook salmon and bull trout in Soos Creek based on the predominance of riffle habitat and insufficient large woody debris throughout much of the sub-basin.

Effects: Pool frequency is expected to be maintained as not properly functioning in the short term and maintained as not properly functioning or restored to at risk in the long term for chinook salmon and bull trout in the Soos Creek sub-basin. This would be accomplished through the combined programs as listed in Table 5-2 that address channel morphology, sedimentation, and flow regimes. Long-term restoration

(in this case to at risk) would rely on habitat restoration activities and the restoration of properly functioning large woody debris recruitment necessary for pool formation.

Pool Quality

Baseline: No data are available on pool quality, but it is assumed to be not properly functioning for chinook salmon and bull trout in the Soos Creek sub-basin. This assumption is based on factors other than pool quality, such as increased sediment impacts, pool frequency, and insufficient large woody debris, which all contribute to decreasing pool quality (Spence et al. 1996).

Effects: Pool quality is expected to be maintained as not properly functioning in the short term and maintained as not properly functioning or restored to at risk in the long term for chinook salmon and bull trout in Soos Creek for reasons similar to those described for pool frequency (listed in Table 5-2).

Off-Channel Habitat

Baseline: No information is available on historic extent, existing extent, or condition of off-channel habitat in the Soos Creek sub-basin. Off-channel habitat is assumed to be not properly functioning for chinook salmon and bull trout due to known alterations of factors that affect off-channel habitat such as large woody debris, riparian vegetation, some blocking culverts, and changes in flow regimes (King County and WSCC 2000).

Effects: Implementing the Model can be expected to maintain the off-channel habitat condition of Soos Creek as not properly functioning in the short term and potentially restore it to at risk in the long term for both chinook salmon and bull trout. Protection of CMZs would facilitate formation of new off-channel areas, and restoration activities could further create off-channel habitat (Table 5-4).

Table 5-4. The Combination of Model Programs and Program Elements that Most Directly Affect Off-Channel Habitat, Refugia, and Floodplain Connectivity[a].

- Incremental improvement of off-channel habitat, refugia, and floodplain connections would require habitat restoration as identified, prioritized, and implemented by jurisdictions through the Monitoring and Adaptive Management and WRIA Based Planning Programs. Habitat Acquisition and Restoration Funding Program has the potential to contribute to restoring these habitat indicators. This assumes that these areas would be appreciably protected by existing regulations (e.g., sensitive area ordinances, federal wetlands regulations, flood management regulations, etc.).
- MZ regulations would be expected to have a long-term effect by protecting the immediate riparian zone, allowing streams to migrate and create new off-channel areas. However, these potential areas are generally limited to areas where riparian buffers are still intact (Appendix M). Due to a relatively fragmented riparian corridor, improvements would not be expected to be sufficient to bring about sub-basin-scale restoration.

[a] The rationale for determinations of effects on the PFC indicators of off-channel habitat, refugia, and floodplain connectivity for sub-basins other than Soos Creek are based on similar combinations of model programs and program elements. Effects determinations for these indicators in other sub-basin analyses reference back to the rationales presented here.

Refugia

Baseline: Refugia is defined as habitat that maintains a high degree of ecological integrity providing existing populations with the greatest probability of surviving natural short- and long-term disturbances (NMFS 1996). Often such areas contain population strongholds that serve as centers of population expansion. Habitat refugia in the Soos Creek sub-basin is not documented in the WRIA 9 LFA (King County and WSCC 2000), however, areas of high quality habitat and naturally reproducing salmonid populations are present, particularly in the lower 6 miles of Soos Creek where most chinook salmon spawn. Refugia is considered at risk for chinook salmon and bull trout in the sub-basin based on the criteria of existing, but inadequately buffered refugia, as specified in the MPIs.

Effects: Implementing the Model can be expected to maintain the existing refugia conditions of Soos Creek as at risk in the short and long term for both chinook salmon and bull trout. Any improvements in habitat resulting from programs or program elements described in Tables 5-2 and 5-4 would serve to improve population strongholds and areas of high habitat value.

Width/Depth Ratio

Baseline: Though no information is available on existing width-to-depth ratios, we assumed that the width-to-depth ratio is not properly functioning for chinook salmon and bull trout in Soos Creek. This assumption is based on extensive areas of low pool to riffle ratios, increased sediment yields, and insufficient large woody debris in the Soos Creek sub-basin, as previously described.

Effects: Width-to-depth ratio is expected to be maintained as not properly functioning in the short term and maintained as not properly functioning or restored to at risk in the long term for chinook salmon and bull trout in the Soos Creek sub-basin. This would be accomplished through the combined programs as listed in Table 5-2 that address channel morphology, sedimentation, and flow regimes.

Streambank Condition

Baseline: Streambank condition is considered at risk for chinook salmon and bull trout in the Soos Creek sub-basin. While there is abundant riparian vegetation (47 to 77% of surveyed stream length; King County 1989), none of the stream system is considered to have good streambank stability because riparian communities are composed primarily of shrubs and small trees. However, shrubs and small trees can provide good streambank stability, particularly for smaller streams (King County and WSCC 2000). Areas currently considered in fair condition are found near stands of small deciduous or mixed conifer/deciduous—these areas have the potential to return to good condition as the stands mature. The extent of bank armoring in Soos Creek is currently unknown, although a hydromodification assessment is in progress (King County and WSCC 2000).

Effects: Streambank condition in the sub-basin is expected to be maintained as at risk in the short term and either maintained as at risk or restored to properly functioning for chinook salmon and bull trout in the long term. This would be accomplished through the combined programs as listed in Table 5-2 that address channel morphology, sedimentation, and flow regimes. Existing riparian vegetation would also be expected to mature and provide greater streambank protection. Areas with no existing riparian vegetation would revegetate, and only streambank stabilization using native vegetation would be allowed by the Model.

Floodplain Connectivity

Baseline: Floodplain connectivity is assumed to be at risk in this analysis for chinook salmon and bull trout in the Soos Creek sub-basin. Connectivity is characterized by reduced linkage of wetland floodplains and riparian areas to the main channel, as well as by degradation of riparian vegetation. Only the lower 2.5 miles of Soos Creek has a well developed, naturally occurring floodplain where the channel is 30 to 40 ft wide and occupies an alluvial valley that is 500 to 800 ft wide. The at risk determination is assumed because bank armoring and disconnection of off-channel habitats have reduced connectivity in this lower floodplain reach and discharge flashiness has likely reduced floodplain recharge, but extensive riparian habitat still exists. No information is available indicating the quantity of bank armoring or disconnection off-channel habitats on off-channel habitat. While it is believed that floodplain connectivity is greatly reduced, the extent is unknown (King County and WSCC 2000).

Effects: Implementing the Model can be expected to maintain floodplain connectivity of Soos Creek as at risk in the short and long term for both chinook salmon and bull trout. While connectivity would improve

as riparian conditions improve, properly functioning floodplain connectivity is unlikely given current and anticipated urbanization. The combination of programs that would most directly affect floodplain connectivity is provided in Table 5-4.

Peak and Base Flow

Baseline: Peak and base flows are considered not properly functioning for chinook salmon and bull trout in Soos Creek based on pronounced changes in flows relative to an undisturbed watershed. The primary impacts on hydrology of the Soos Creek sub-basin are stormwater runoff and consumptive use associated with urbanization. Construction of impervious surfaces increases stormwater peak flow and durations and creates new peaks that increase frequency and degree of sediment/bedload movement, streambank erosion, and sediment deposition. In addition, urbanization and groundwater withdrawals have reduced summer base flows—average 7-day low flows significantly decreased from 1968 to 1993. Surface water rights and claims amount to a total of 27 cfs. In addition, rapid runoff reduces summer low flows by reducing recharge of shallow aquifers.

Effects: Peak flows and durations are expected to be maintained as not properly functioning in the short term and maintained as not properly functioning or restored to at risk for chinook salmon and bull trout in the long term. The combination of factors described in the first two bullets of Table 5-2 would prevent increases in peak flows and durations, and by matching flows from already-cleared sites to forested conditions, would reduce peak flows and durations. This condition may also be improved where stormwater plans identify and implement practicable improvements (i.e., regional facilities) for reducing peak flows and durations

Base flows are expected to be maintained as not properly functioning in the short and long term for chinook salmon and bull trout. As discussed in Appendix B, the Rural 65/10 Residential Site Standard would limit new effective impervious area and minimize the loss of forest cover in the rural portions of the Soos Creek sub-basin. This would retain pervious areas and reduce effects of development on base flows. However, the Rural 65/10 Residential Site Standard would not apply to the urban portions of the Soos Creek sub-basin. As discussed in Section 4.3.2.1, full dispersion of runoff, soil amendments, infiltration/dispersion BMPs, and infiltration facilities would be expected to reduce loss of infiltration and groundwater inputs to Soos Creek and its tributaries. The effectiveness of these actions on a sub-basin scale is uncertain. Increased urbanization may also increase withdrawals and degrade base flows, particularly in portions of the sub-basin not served by municipal water supplies.

Drainage Network and Road Density

Baseline: The properly functioning drainage network criteria of the MPIs (i.e., zero or minimum increases in drainage network density due to roads) is considered to be not properly functioning for Soos Creek. The MPI criteria were developed for evaluating impacts on higher elevation, more confined, forested watersheds. However, densities of roads, ditches, and drains certainly adversely affect stream function within the Soos Creek sub-basin.

The average road density of Soos, Covington, and Jenkins Creeks is estimated to be 7.4 mi/mi^2, according to the Tri-County GIS database (Tri-County 2001a). In addition, many roads are located in valley bottoms. However, as with drainage network, though road density is likely not an appropriately defined indicator for lowland streams, it was assumed to be not properly functioning due to the obvious increases in road density throughout the sub-basin.

Effects: No effects determination was made because drainage network and road density criteria are likely not appropriately defined for drainage network and road density conditions in Puget Sound lowland

streams. No Model program elements are specifically designed to address the drainage network or road density and location. However, the following elements may be applicable:

- The land use element within the Stormwater Management Program requires cities and counties to use best available science in designating and protecting critical areas when comprehensive land use planning, zoning, and other land use decisions are made. However, because this requirement does not specifically address roads in stream valleys, there is appreciable uncertainty regarding the implementation and outcome of this program element.
- The fish habitat ranking principles element within the Stormwater Management Program may discourage construction or expansion of new roads in valley bottoms. However, this requirement does not specifically address roads in stream valleys, which creates appreciable uncertainty regarding the implementation and outcome of this program element. This element would not be expected to reduce the number of existing roads nor would it be expected to address upland roads and, therefore, it would not address drainage density.

Disturbance History

Baseline: Disturbance history for the Soos Creek sub-basin is extensive and considered not properly functioning based on the MPI criteria of extensive disturbance relative to historical conditions (NMFS 1996). The MPI criteria for a not properly functioning disturbance history also requires that there be no late successional old growth retention (LSOG). This may or may not be applicable to the lower Puget Sound region. However it is assumed for this analysis that the Soos Creek sub-basin is sufficiently disturbed to warrant a rating of not properly functioning.

Effects: Disturbance history would be expected to be maintained as not properly functioning for chinook salmon and bull trout in the Soos Creek sub-basin, based on the following program elements:

- In the rural portion of Soos Creek, the Rural 65/10 Residential Site Standard would be expected to minimize the loss of existing forest cover. As demonstrated in Appendix B, the Rural 65/10 Residential Site Standard applied on a parcel-by-parcel basis throughout the sub-basin would result in less than 65% forest cover because Soos Creek has only 26% existing forest cover. Because some parcels may have more than 65% forest cover, some additional clearing may actually occur. Some reforestation may also occur, because the standard requires subdivisions to reforest to achieve 65% forest cover. Reasonable-use exceptions may modify the 65% forest cover, but these would require additional mitigation to compensate for the reduced forest cover. The Rural 65/10 Residential Site Standard would not apply to urban designated areas in the Soos Creek sub-basin.

Riparian Reserves

Baseline: The lack of mature trees throughout the Soos Creek sub-basin limits riparian reserve function and is considered not properly functioning for chinook salmon and bull trout based on fragmented riparian reserves criteria (Table 5-5) and a less than 25% similarity to natural conditions. Roads and development also limit sediment filtration to areas of dense stands of young trees. Based on existing buffer widths and predicted function, little of the existing habitat provides good riparian function (Table 5-6). The larger (2nd and 3rd order) channels are generally visible from the air, which indicates that shade levels are less than 40%--the target shading to maintain temperatures at less than 16ºC in Soos Creek is 80 to 90% over the sub-basin (King County and WSCC 2000). There are reaches, however, that could provide increased shading if undisturbed over time.

Table 5-5. Riparian Forest Cover in the Soos Creek Sub-basin (King County and WSCC 2000)

Stream Name	Total Length Surveyed (miles)	Forested Length (miles)	Percent Forested Length (%)
Soos	14.2	8.9	63
Little Soos	4.5	2.1	47
Soosette	5.1	3.0	59
Covington	11.3	8.7	77
Jenkins	6.0	3.7	62
Totals	41.1	26.4	61.6

Table 5-6. Riparian Function[a] in the Soos Creek Sub-basin (King County and WSCC 2000)

Riparian Function	Good (%)	Fair (%)	Poor (%)	Total (%)
Shade	0	22	78	100
Organic Material Recruitment	0	22	78	100
Sediment Filtration	45	12	43	100
Large Woody Debris	0	0	100	100
Microclimate	0	0	100	100

[a] Degree of function is based on existing riparian vegetation and associated function. For example, shade is considered to be in good condition only where there are dense stands of medium or large trees, which does not occur along Soos Creek. However, 22% of Soos Creek stream length surveyed was determined to have riparian vegetation adequate to provide fair shading function. See (King County and WSCC 2000)

Effects: Riparian reserves are expected to be maintained as not properly functioning in the short term within the MZ areas, and maintained as not properly functioning or restored to at risk in the long term for chinook salmon and bull trout, based to the following program element:

- MZ regulations in the Land Management Program would not significantly increase or decrease the area of riparian reserves in the short term (Appendix M), but the quality of existing riparian vegetation and soils would be expected to increase and, therefore, improve the long-term functional value of the riparian reserves under both the rural and urban standards. Most of the existing riparian corridor (whether within a 115-ft or 150-ft MZ) would be allowed to mature because retained vegetation would be protected. Though both standards would improve conditions, only the rural standard would provide the potential for achieving properly functioning riparian reserves.

While increased development would certainly allow for some additional clearing within the MZ, restrictions on allowable uses, habitat evaluations, and required mitigation for many uses would ensure protection of riparian function (Section 4.3.1.1, Appendices G, H, and I). However, the extent of additional clearing is unknown. Apart from forest lands that are being converted to other uses, forest lands in the Tri-County region are subject to state or federal regulation, not local regulation. As a result, neither the municipal, residential, commercial, and industrial (MRCI) limit nor the Tri-County Land Management Program address forest management activities. Significant clearing of MZs could occur under non-conversion Forest Practice Permits. MZs would be replanted, but would be left with seedlings or immature forest for several decades. This would result in an initial decrease of habitat function that would take a long time to restore. Protection of MZs under the Model would not result in an initial decrease, but rather would improve from the existing conditions.

This analysis assumes that the new permanent rules adopted by the Washington State Forest Practices Board, consistent with the 1999 Forest and Fish Report, will contribute to the attainment and maintenance of PFC in habitat for threatened Puget Sound chinook salmon and bull trout in the Tri-County region, wherever they are applied. This analysis also assumes that that forest management activities conducted on federal lands in the Tri-County region, which are subject to the consultation requirement of ESA Section 7(a)(2) will be analyzed by the Services using the MPI and also contribute to the attainment and maintenance of PFC in habitat for threatened Puget Sound chinook salmon and bull trout in the Tri-County region. But this analysis does recognize that removal of existing MZ vegetation under forest practices regulations is not consistent with the Model and represents a mechanism by which significant clearing of riparian vegetation within designated MZs could occur.

5.2.1.2 Soos Creek: Overview of Results and Conclusions

Implementing the Model is expected to maintain existing habitat conditions in UGA and non-UGA portions of the Soos Creek sub-basin in the short term. Because current conditions are generally not properly functioning or at risk, maintaining existing conditions means habitat conditions would remain not properly functioning or at risk. The Soos Creek sub-basin contains an approximately equal mix of UGA and non-UGA area, with the majority of chinook salmon spawning occurring in the non-UGA lower sections of mainstem Soos, Covington, and Jenkins Creeks. Riparian buffers are extensive in these reaches, but largely immature.

The fixed regulation MZs would not significantly increase or decrease the area of existing, and often not fully functional, riparian reserves in the short term; however, the quality of existing riparian vegetation and soils would increase in the long term. Protection of riparian buffers would also allow streams to migrate and create new off-channel areas. These potential new areas are generally limited to areas where riparian buffers are still intact, and presumably most of the existing riparian corridor would be allowed to mature because retained vegetation would be protected. While increased development would allow for some additional clearing within the MZ, restrictions on allowable uses and required mitigation for many uses would be in place to ensure protection of riparian functions. The rural MZ has the potential to support properly functioning conditions for many indicators, particularly for large woody debris, which heavily influences many important stream habitat functions. Though properly functioning conditions are not attainable under the urban standard, the condition of riparian vegetation within a narrower buffer would still improve.

The extent of additional clearing due to forest practices would be governed by state and federal regulations. This represents a challenge to implementation of the Model because jurisdictions would have to estimate the amount and effect of forestry-related clearing that will be allowed in riparian areas designated for forest production within MZs across the landscape. Apart from areas subject to forestry, pervious riparian areas that have little existing riparian vegetation would be maintained in a condition that would not preclude future habitat restoration. Generally, habitat conditions in areas with little existing riparian buffer would improve over time only to the extent that restoration activities are implemented through the Habitat Acquisition and Restoration Funding, WRIA Based Planning, and Monitoring and Adaptive Management Programs.

5.2.2 NEWAUKUM CREEK

The Newaukum Creek sub-basin has a drainage area of approximately 27.8 mi^2 and contains about 27.5 miles of stream, including tributaries. There are three distinct channel types within the Newaukum Creek sub-basin: the upper sub-basin (RM 14 to RM 9) is a high-gradient contained channel; the Enumclaw Plateau (RM 9 to RM 3) is a low-gradient floodplain channel; and RM 3 to the mouth is a moderate-to-high gradient confined channel, except for a small alluvial fan section at its confluence with the Green River.

The sub-basin is rural, with agriculture accounting for 47% of the designated use (King County and WSCC 2000). Existing residential use accounts for 22% of the sub-basin and is approaching the designated residential use-limit of 29%. Approximately 28% of the sub-basin is forested and consists primarily of early to-mid-successional deciduous and mix-forest types. Forest areas are concentrated in the upper and lower reaches, where the channel is confined by steep topography. Forest cover in the Enumclaw Plateau reach has largely been replaced by agriculture. Approximately 15% of the sub-basin is within the UGA boundary (Appendix C) and is concentrated around the City of Enumclaw.

Chinook, coho, pink, chum, and sockeye salmon, along with cutthroat trout and winter steelhead, naturally spawn in the Newaukum Creek sub-basin. Bull trout are not known to use Newaukum Creek, however, they have been documented in the mainstem Green River up to and at the mouth of Newaukum Creek. The upstream extent of anadromous salmonid distribution in Newaukum Creek is believed to be at RM 13.0, where there is an impassable cascade, and chinook salmon have been found spawning as far upstream as RM 11.3. The Newaukum Creek sub-basin is considered a major producer of chinook salmon, coho salmon, and winter steelhead in the Puget Sound region (King County and WSCC 2000).

5.2.2.1 Newaukum Creek: Overview of Results and Conclusions

The combined effects of the Model regulations would be expected to maintain the existing condition of salmonid habitat indicators in Newaukum Creek in the short term, and maintain or restore some salmonid habitat indicators in the long term (Appendix L; Table L-1). The effects of Model programs on baseline conditions are generally the same as described for Soos Creek for the following PFC indicators: water temperature, width/depth ratio, streambank condition, substrate, sediment, pool frequency and quality, peak/base flow, chemicals, physical barriers, large woody debris, off-channel habitat, refugia, floodplain connectivity, drainage network, and road density.

Implementing the Model would be expected to maintain existing habitat conditions in UGA and non-UGA portions of the Newaukum Creek sub-basin in the short term, as described for the Soos Creek sub-basin. The Model would maintain habitat conditions at their existing generally not properly functioning or at risk condition. The fixed regulation MZs would not significantly increase or decrease the area of existing, and often not fully functional, riparian reserves in the short term. However, the quality of existing riparian vegetation and soils would increase in the long term. Habitat conditions in areas with little existing riparian buffer would improve over time only to the extent that restoration activities are implemented through the Habitat Acquisition and Restoration Funding, WRIA Based Planning, and Monitoring and Adaptive Management Programs. Currently, the Newaukum Creek sub-basin has a substantial area designated as agricultural use (47.3%), which is not covered by the Model.

5.2.3 MIDDLE GREEN RIVER

The Middle Green River sub-basin has a drainage area of approximately 41,000 acres that extends from Howard Hanson Dam at RM 64.5 to RM 32, just downstream of the confluence with Soos Creek. The upper Middle Green River is strongly confined where it flows through the Green River gorge. The river is a floodplain channel type downstream from the gorge. Much of the Middle Green sub-basin remains rural, but increasing urbanization with associated land use impacts is expected. Currently, the Middle Green River sub-basin is approximately 60% forested (primarily deciduous or mixed-forest types) and only 15% is residential (King County and WSCC 2000), with about 36% of the sub-basin designated residential and 40% designated commercial forest. Only 5% of the total sub-basin area is within the UGA boundary (Appendix C). TIA within the UGA is 25.5%, and TIA outside the UGA is 4.6%.

Chinook, coho, pink, and chum salmon, as well as cutthroat trout, winter steelhead, and bull trout, use the Middle Green River. There have been many observations of bull trout over the past few years in the Middle Green River, with the current known bull trout distribution up to RM 41 (mouth of Newaukum

Creek) and distribution presumed up to RM 61 at Headworks Dam. In particular, the Middle Green River has a substantial spawning population of ESA listed wild fall chinook salmon. From 1968 to 1996, the total Green River supported an average yearly run of 41,000 adult chinook salmon comprised of 24,000 hatchery fish (originating from the Soos Creek Hatchery) and 17,000 wild fish (wild and hatchery strays combined that spawn in-river). This substantial run of chinook appears to have a considerable mixture of hatchery and naturally spawning wild fish. Spawning primarily occurs between RM 24.0 and RM 61.0, with concentrated spawning activity fluctuating from year to year. Areas of preferred spawning have been documented from RM 29.6 to 47.0, RM 56 to 61, near the confluence of Soos and Icy Creeks, and in the Green River gorge.

Green River flows are regulated by the operation of the Tacoma Headworks Dam (RM 61) and Howard Hanson Dam. Regulation of flows is likely the single biggest influence on Green River habitat functions. Modifications, such as dams, change natural flow regimes by reducing the magnitude and altering the timing of natural flushing flows. In addition, upstream dams reduce the recruitment of new spawning gravel and large woody debris that are necessary for proper stream function. This regulation of flows is insufficient to allow channel migration and the habitat-forming processes that are necessary for proper floodplain function and creation of salmonid habitat. The MPI is often not applicable to the mainstem Middle Green River because of the controlling effect of the dams and other modifications (dikes, water withdrawal, etc.). However, because the MPI was developed for smaller streams, it is more applicable to smaller Middle Green River tributaries and should be considered by jurisdictions when applying the Model.

5.2.3.1 Middle Green River: Overview of Results and Conclusions

Current baseline PFC indicators in the Middle Green River sub-basin are indicative of an actively developing rural area. The baseline condition of this sub-basin and the predicted effects of the Model are summarized in Table L-2 in Appendix L.

Combined actions from implementation of the Model would be expected to help maintain salmonid habitat in the Middle Green River sub-basin in the short and long term, based on the analysis of specific PFC indicators discussed in Appendix L. However, the effects of Model programs will likely be outweighed by the effects of upstream dams on flows. On smaller tributaries where riparian functions exert more control over stream habitat, program effects would be similar to those described for Soos Creek (Section 5.2.1), provided that baseline conditions are also similar to Soos Creek. Additional or different predicted effects in the Middle Green River sub-basin are discussed in detail in Appendix L. If not otherwise indicated, effect determinations throughout this sub-basin are based on the controlling influence of upstream dams.

We expect implementation of the Model to maintain existing not properly functioning or at risk habitat conditions in UGA and non-UGA portions of the Middle Green River sub-basin in the short and long term. As with the Soos Creek sub-basin, the fixed regulation MZs would not significantly increase or decrease the area of existing, and often not fully functional, riparian reserves in the short term, however, the quality of existing riparian vegetation and soils would increase in the long term. The greatest factor influencing habitat conditions in the Middle Green River is the flow regime determined by the upstream dams.

5.2.4 LONGFELLOW CREEK

Longfellow Creek, located near the mouth of the Duwamish River, drains an area of 2,685 acres and contains about 4.2 miles of historical stream length; approximately 30% of this historical stream length is now piped. The Longfellow Creek sub-basin is heavily urbanized, and impervious surface areas range from 35 to 50% in the upper, middle, and lower parts of the sub-basin. Residential, commercial, and

industrial use dominates the Longfellow Creek sub-basin, accounting for over 80% of existing use, which approaches the values for designated use (King County and WSCC 2000). Existing forest is virtually non-existent, and 100% of the sub-basin area is within the UGA boundary. Habitat conditions have improved through recent restoration activities in a segment of the lower portion of Longfellow Creek.

Adult and juvenile coho salmon and juvenile rainbow trout are documented in Longfellow Creek, but the occurrence and extent of natural reproduction is unknown. Chinook salmon and bull trout are not known to use Longfellow Creek for spawning or rearing. They may forage near the mouth of the creeks during migration.

Current baseline PFC indicators in the Longfellow Creek sub-basin are indicative of a highly developed urban area. The baseline condition of this sub-basin, and the predicted effects of the Model, are summarized and discussed in Table L-3 in Appendix L.

5.2.4.1 Longfellow Creek: Overview of Results and Conclusions

The combined actions of implementing the Model are expected to maintain chinook salmon and bull trout habitat indicators as not properly functioning in the Longfellow Creek sub-basin in the short term, and maintain or restore indicators to at risk in the long term. This conclusion is based on the analysis of specific habitat indicators discussed below. It is anticipated that substantial restoration implemented throughout the Monitoring and Adaptive Management, Habitat Acquisition and Restoration Funding, and WRIA Based Planning Programs would be required to move the indicators from not properly functioning to at risk. In most cases, the effects of individual Model programs (Chapter 6) are synergistic on a sub-basin scale, as discussed in Chapter 7.

Program effects for the Longfellow Creek sub-basin are generally the same as for Soos Creek (see Section 5.2.1.1) for the following PFC indicators: water temperature, width/depth ratio, streambank condition, substrate, sediment, pool frequency and quality, peak/base flow, chemicals, physical barriers, off-channel habitat, refugia, and floodplain connectivity. Additional or different predicted effects in the Longfellow Creek sub-basin are described below.

Implementing the Model would be expected to maintain existing not properly functioning habitat conditions in the short term within the Longfellow Creek sub-basin. The majority of the sub-basin is currently in residential and commercial use that would only be affected by the Model as these areas are re-developed. Riparian vegetation is limited and a significant portion of the stream length is contained in pipes. However, riparian areas that have little existing vegetation would be maintained in a condition that would not preclude future habitat restoration. Habitat conditions would improve in the Longfellow Creek sub-basin only to the extent that restoration activities are implemented through the Habitat Acquisition and Restoration Funding, WRIA Based Planning, and Monitoring and Adaptive Management Programs.

5.2.5 HAMM CREEK

Hamm Creek is a tributary of the Duwamish River that drains an area of 1,408 acres. The Hamm Creek sub-basin is heavily urbanized, with high impervious surface area. The North, Middle, and Lost Forks of Hamm Creek are almost entirely contained within pipes. Only the South Fork of Hamm Creek contains available stream habitat within a recently restored stream channel from RM 0 to 0.5 and a steep ravine section from RM 0.6 to 1.1. This reach is well buffered from surrounding urbanization because steep slopes have precluded development. Existing forest is limited to the previously described steep ravine reach and 100% of the sub-basin area is within the UGA boundary.

Anadromous salmonids utilize the South Fork of Hamm Creek. Coho salmon have been observed spawning below RM 0.7, and both juvenile coho salmon and cutthroat trout have been collected or

observed up to RM 1.0. Chinook salmon and bull trout do not inhabit Hamm Creek, but would be expected to aggregate at the mouth during migration or for feeding (bull trout).

Current baseline PFC indicators in the Hamm Creek sub-basin are indicative of a highly developed area, and the baseline conditions of all habitat indicators are not properly functioning.

5.2.5.1 Hamm Creek: Overview of Results and Conclusions

Our analysis indicates that for Hamm Creek, the effects of implementing the Model would be very similar to those for Longfellow Creek (except for MZs; Appendix M), since both streams are highly altered and located in built-out urban sub-basins. All habitat indicators were determined or assumed to be not properly functioning due to the high degree of urbanization in these sub-basins. The primary difference between existing conditions in Hamm and Longfellow Creeks is that a greater percentage of Longfellow Creek is not contained within pipes. Thus, there appears to be a somewhat greater potential restoration opportunity than in the Hamm Creek sub-basin (not withstanding recent restoration activity near the mouth of Hamm Creek). The long-term effects determinations for Hamm Creek are to maintain not properly functioning conditions for all indicators, whereas Longfellow Creek likely has potential for improvement.

5.2.6 LOWER DUWAMISH RIVER

The existing Lower Duwamish River is currently in a highly altered condition. Historically, the Green, White, Black, and Cedar Rivers flowed into the Duwamish River, and the system drained an area of more than 1,600 mi^2. In the early 1900s, the Black, White, and Cedar Rivers were diverted to Lake Washington, reducing the Green River drainage by more than 60% to just 483 mi^2 (Blomberg 1995). The White River, which was formerly part of the Green River System, was permanently diverted to the Puyallup River drainage in 1906 (Weitkamp and Ruggerone 2000). In 1913 the City of Tacoma constructed a diversion dam on the Green River, near the town of Palmer at about RM 50.0. Then in 1963, the Howard Hansen Dam was built at RM 53.0.

More than 98% of the historic tidal marsh, flats, shallows, and wetlands have been eliminated from the Lower Duwamish River sub-basin. The Lower Duwamish River is an estuary that has been extensively altered by industrial and urban development; saltwater intrusion extends to about RM 11.0. The lower portion of the river is extensively armored and channelized to facilitate navigation and industrial development. Residential, commercial, and industrial use dominates the sub-basin and accounts for over 80% of existing use, which is approaching the values for designated use (King County and WSCC 2000). Existing forest is virtually non-existent, and 100% of the sub-basin area is within the UGA boundary. The Lower Duwamish River is used as a migration corridor by all anadromous salmonids of the Green River Watershed. What little intertidal habitat remains is utilized as juvenile salmonid rearing and feeding habitat. Sub-adult and adult bull trout are believed to use this area for foraging habitat based on past and recent observations. The Duwamish River stock of chinook salmon currently has a higher smolt-to-adult survival rate than any other drainage system within the Puget Sound evolutionarily significant unit (ESU; Weitkamp and Ruggerone 2000).

MPI criteria were developed for small, forested streams unlike the Lower Duwamish River estuary. Though criteria for properly functioning estuaries are not developed, systems such as the Lower Duwamish River do provide important habitat functions for anadromous salmonids, and the effects of management actions on those functions must be addressed. The following baseline condition determinations are based on the MPI, when applicable. Other important indicators for bull trout that could be included in the MPIs are estuarine and nearshore marine areas, would-be shallow/intertidal habitat, and forage fish spawning habitat/beaches, but such criteria are not included in this analysis.

Current baseline PFC indicators in the Lower Duwamish River sub-basin are indicative of a highly developed urban area. Baseline conditions for the Lower Duwamish River sub-basin, together with the predicted effects of the Model, are summarized in Table L-4 in Appendix L.

5.2.6.1 The Lower Duwamish River: Overview of Results and Conclusions

The combined actions of implementing Model program are expected to maintain salmonid habitat as not properly functioning in the Lower Duwamish River sub-basin in the short and long term for chinook salmon and bull trout. Model effects are generally the same as those described for Soos Creek (see Section 5.2.1.1), namely to maintain existing conditions. In the case of the Lower Duwamish River sub-basin, the high-level of urbanization precludes restoration of habitat indicators through early action Model regulations, therefore, improvements to habitat would rely on restoration activities implemented through the Habitat Acquisition and Restoration Funding, Monitoring and Adaptive Management, and WRIA Based Planning Programs.

Implementing the Model would be expected to have minor effects on habitat conditions within the Lower Duwamish River sub-basin in the short and long term, with the possible exception of the habitat restoration action conducted through the Habitat Acquisition and Restoration Funding Program. Because the Lower Duwamish River sub-basin is primarily devoted to industrial, commercial, and residential uses, habitat conditions would be effected by the Model only as these areas are redeveloped. However, the Model includes provisions that allow existing development footprints to be maintained. While riparian areas that do not currently have natural vegetation would be maintained in a condition that will not preclude future habitat restoration, most of this sub-basin has little or no riparian vegetation. Currently, the Lower Duwamish River has few habitat indicators in PFC, however, recently restored habitat has improved conditions within some small areas. The Model would incrementally improve habitat conditions over time in the Lower Duwamish River sub-basin through the Habitat Acquisition and Restoration Funding Program only to the extent that this program is applied. The WRIA Based Planning Program would provide the direction to guide the funded actions in a manner that is appropriate for the state of knowledge at the time the actions are taken. Over the long term, these programs have the potential to provide improvements of uncertain extent and magnitude in habitat conditions for salmon and bull trout.

5.3 OVERALL SUB-BASIN ANALYSIS CONCLUSIONS

The selected sub-basins differ substantially in their existing land use and habitat conditions. Soos Creek is a mix of UGAs and non-UGAs, with substantial existing habitat resources. Newaukum Creek is almost entirely non-UGA, and largely dominated by agricultural use. The Middle Green River has substantial natural habitat, but habitat processes are highly influenced by operation of upstream dams. Most of the Longfellow Creek, Hamm Creek, and Lower Duwamish River sub-basins have little natural riparian habitat remaining. These urban sub-basins are primarily devoted to residential, commercial, and industrial use that would be affected by the Model only as developed areas are redeveloped.

Implementing the Model would be expected to maintain existing habitat conditions in urban and rural sub-basins in the short term based on this sub-basin analysis. Because conditions are generally not properly functioning or at risk in the sub-basins analyzed, maintaining existing conditions means that conditions would be maintained as not properly functioning or at risk. As demonstrated in the MZ analysis (Appendix M), the current distribution of immature and mature vegetation would be maintained within the proposed MZ boundaries. Where this occurs, habitat functions would likely improve as riparian vegetation matures over time. Riparian areas that do not currently have natural vegetation, including agricultural areas, would be maintained in a condition that would not preclude future habitat

restoration opportunities, but would not improve as a result of the affect of the Model on riparian conditions.

The Model does have the potential to provide substantial improvements in habitat conditions for salmon and bull trout in the long term. Such improvements would depend on the extent that restoration activities are implemented according to best available science through the Habitat Acquisition and Restoration Funding, WRIA Based Planning, and Monitoring and Adaptive Management Programs.

5.4 APPLICABILITY OF SUB-BASIN ANALYSIS TO THE TRI-COUNTY AREA

This section includes an overview of how the existing land use designations (UGA/non-UGA) and vegetation cover in the selected sub-basins compare to sub-basins throughout the Tri-County area. While this section provides an indication of the relevance of the sub-basin analysis to the greater Tri-County area, this is not an attempt to predict how all sub-basins in the Tri-County region would respond to the Model. Such an extrapolation of the sub-basin results would be indefensible without detailed information on baseline conditions. Instead, this section describes the similarity of land use designations and vegetation cover of the selected sub-basins to all Tri-County sub-basins and broadly generalizes the applicability of the sub-basin analyses. Applicability of the sub-basin analyses to other sub-basins in the Tri-County region depends on the similarity of type and extent of land use in the sub-basins and similarity of habitat conditions. This section also describes the distribution of chinook salmon and bull trout spawning populations relative to land use designations within the Tri-County region.

There are 159 sub-basins in the Tri-County GIS database (Tri-County 2001a). Among the sub-basins, 28 are entirely within the UGA, and 56 are entirely within non-UGA designated areas(Appendix C). Table 5-7 compares the percentages of existing vegetation cover in the selected sub-basins to the median values for vegetation cover of all sub-basins combined (including those that are exclusively UGA or non-UGA). Median values were chosen to provide a general metric identifying the number of sub-basins (i.e.,<> 50%) that have a certain percentage of land use designation or vegetation cover. Half of the Tri-County sub-basins have ≥ 94.6% designated non-UGA and half have ≥ 74.3% vegetated non-UGA area. Half of the Tri-County sub-basins have ≤ 5.4% designated UGA area and half have ≤ 3.4% vegetated UGA area. This indicates that most sub-basins in the Tri-County area are almost entirely non-UGA and are well-vegetated. Areas outside the UGA would either receive the rural MZ standards or be subject to state and federal forest management regulations. These standards are assumed to contribute to the attainment and maintenance of PFC in habitat for threatened Puget Sound chinook salmon and bull trout in the Tri-County region wherever they are applied (as described in Section 5.2.1.1 under riparian reserves).

A comparison of the selected sub-basins to all Tri-County sub-basins with respect to UGA designations and vegetation cover is summarized as follows:

- Soos Creek is an even mix of UGA and non-UGA lands. Existing vegetation is evenly distributed on UGA and non-UGA lands. It has a greater percentage of UGA and less existing vegetation than most sub-basins. This sub-basin is actively urbanizing and the sub-basin analysis approximates how similar sub-basins would respond to the Model. Relatively few Tri-County sub-basins have equal mixes of UGA and non-UGA lands such as Soos Creek (only 12 sub-basins fall within the range of 40 to 60% UGA).
- Newaukum and the Middle Green River sub-basins lie near the median for the percentage UGA and vegetation cover and are representative of the majority of Tri-County sub-basins with respect to these categories.

- Longfellow Creek, Hamm Creek, and the Lower Duwamish River sub-basins are entirely UGA designated. While 28 other sub-basins are entirely UGA, a total of only 50 contain ≥ 50% UGA. The Longfellow Creek and Duwamish River sub-basins are representative of highly urbanized sub-basins. Hamm Creek was not called out specifically in the Tri-County database, but has land use characteristics similar to Longfellow Creek.

Table 5-7. Comparison of Percentages of Land use Designations and Existing Vegetation Cover in Selected Sub-Basins to Median Values for All Tri-County Sub-Basins Combined[a]

Sub-basin	UGA Area	Non-UGA Area	Existing UGA Forested	Existing UGA Other Veg[b]	Existing UGA All Veg	Existing Non-UGA Forested	Existing Non-UGA Other Veg	Existing Non-UGA All Veg
Soos[c]	59.2	40.8	6.4	21.4	27.7	9.1	20.6	29.7
Newaukum Creek	15.0	85.0	0.6	7.5	8.1	16.5	54.7	71.2
Middle Green River	5.3	94.7	1.4	1.9	3.2	39.9	43.0	82.9
Longfellow Creek	100.0	0.0	7.0	18.2	25.2	0.0	0.0	0.0
Duwamish River	100.0	0.0	5.7	13.1	18.8	0.0	0.0	0.0
Median for all Sub-basins [d]	5.4	94.6	----	----	3.4	----	----	74.3

[a] Data in this table are summarized from Appendix C. Values represent the percentage of the entire sub-basin area

[b] Other veg = combined scrub/shrub, crops, and grass.

[c] This example for the Soos Creek sub-basin and does not include Covington and Jenkins Creek sub-basins listed in Appendix C.

[d] These are the median values for all sub-basins in the Tri-County Database. Median values represent specific sub-basins for each particular land use designation and vegetation type. The median values for different vegetation types were not included to avoid falsely implying that levels of existing forest correspond to some level of existing other vegetation. Since the Model protects both forested and non-forest vegetation, median percentages for all vegetation are a more appropriate indicator of the levels of existing vegetation relative to the number of Tri-County sub-basins. The percentages of each vegetation type in the selected sub-basins were included because they correctly associate the existing levels of forest and other vegetation.

As presented in Appendix M, the more restrictive land use regulations (e.g., MZs, Rural 65/10 Residential Site Standards) would be applied to rural (non-UGA) lands. The rural standard would be expected to protect habitat consistent with the sub-basin analyses of the Middle Green and Newaukum Creek sub-basins, which are located almost entirely outside the UGA (Appendix C). Where there is existing abundant riparian vegetation, there will be a high degree of retention (Appendix M) and the potential to provide for full function of many habitat indicators. Of particular significance would be providing for adequate large woody debris recruitment. If riparian vegetation is lacking (most notably as in agricultural portions of Newaukum Creek), then habitat restoration or acquisition would be necessary to improve or provide additional habitat functions.

Less restrictive land use regulations would apply to urban (UGA) lands, but protection of existing conditions would be similar because existing conditions are generally more degraded. For example, Longfellow Creek, Hamm Creek, and the Lower Duwamish River are entirely in the UGA and are already highly urbanized. The UGA MZ standards would protect the limited existing riparian habitat in these sub-basins because little riparian vegetation remains beyond the urban IMZ standard of 115-ft. In this respect, the urban and rural MZ standards would provide equal protection (Appendix M), but riparian vegetation in the UGA extending beyond the 115-ft IMZ would be susceptible to clearing under the urban standard. Generally, urbanized streams would only have improved habitat functions through active

habitat restoration. Areas of high habitat value or high habitat potential, as discussed in Section 4.3.1.2, would require wider MZs to achieve properly functioning conditions that would adequately support chinook and bull trout populations as they occur within the UGA.

Lucchetti (2002) classified stream miles of the Tri-County region according to chinook use of habitat for spawning. The ratings are considered a conservative measure of the potential for chinook reproduction in a given area. Habitat is included that provides marginal spawning conditions for chinook. The classifications are as follows:

- "A **moderate to high** rating signifies habitat in which chinook are known to spawn and that is characterized by adequate flows and physical attributes (e.g., channel size, gradient, and substrate) that typically support chinook spawning. These reaches exhibit consistent spawning of more than a few individuals within a given year and also from year to year. Multiple observations of chinook spawning would also qualify a reach to be included in this category."
- "A **low** rating signifies habitat that is characterized by marginal flows and/or physical attributes (e.g., size, gradient, and substrate) that support only rare, infrequent, sporadic, or very low levels of chinook spawning. Chinook spawning, when it occurs in these habitats, is generally associated with extremely favorable flows and high system-wide spawning escapements."
- "A **no** rating signifies habitat that is characterized by flows and/or physical attributes (e.g., channel size, gradient, and substrate) that are clearly incapable of supporting chinook spawning. Examples of such habitats include the lowermost, primarily silt-bedded reaches of mainstem rivers, such as the Nisqually, Puyallup, Duwamish/Green, Snohomish and Stillaguamish Rivers as they make their final approach into estuarine areas and Puget Sound and very small and/or steep tributaries."

Within the Tri-County Region, 18.5% of the chinook-bearing stream miles are within the UGA (Appendix K). Of these UGA chinook bearing stream miles (presented as the percentage of all chinook stream miles in the Tri-County region), 9.5% have moderate to high quality spawning habitat, 4% have low quality, and 4.9% have no spawning potential classifications within the Tri-County UGA. Most (81.5%) of the chinook-bearing stream miles in the Tri-County area are located outside the UGA and would receive the more restrictive MZ standards.

Of the UGA stream miles conservatively classified as moderate to high chinook spawning habitat, most (62%) are located in WRIA 8, consisting of the lowermost reaches of the Cedar River, Big Bear Creek, Issaquah Creek, and portions of Kelsey Creek. Although conservatively classified as moderate to high, most of this spawning habitat within the UGA does not support high levels of chinook spawning relative to areas of WRIA 8 outside of the UGA such as the upper reaches of the Cedar River, Big Bear Creek, and Issaquah Creek. Other areas identified as providing moderate to high chinook salmon spawning habitat include 12.7 miles of stream in WRIA 9 (Green/Duwamish watershed) concentrated in the lower Green River and Soos Creek; 28.3 miles of stream in WRIA 10 (Puyallup watershed) concentrated in the lower White River, Carbon River, and Boise, South Prairie, and Hylebos Creeks; 5.3 miles of stream in WRIA 11(Nisqually River watershed) all located within the Town of Eatonville; and 5 miles of stream in WRIA 12 (Chambers Creek watershed) all located in Chambers Creek.

There is no known bull trout spawning habitat within the UGA. The fish-bearing streams in the UGA are low in elevation relative to streams that typically provide the cold water temperatures necessary for spawning, incubation, and early rearing of bull trout (Lucchetti 2002). It is likely that the majority, if not all, bull trout spawning habitat would be subjected to the more restrictive non-UGA standards.

Stream reaches in the UGA do support important functions such as migration, foraging, and rearing for chinook and bull trout. While these aspects of life history are important for survival, spawning and early rearing habitat is likely the most critical freshwater habitat for sustaining salmonid populations in the

Puget Sound region. This assumption is supported by the apparent specificity of bull trout spawning habitat requirements and the observation that systems such as the Green River and Lake Washington watersheds have highly degraded lower mainstem reaches and estuarine rearing habitats, yet support modest to healthy chinook salmon populations because of the presence of upstream spawning habitat.

In summary, the sub-basin analysis shows most sub-basins within the Tri-County region are designated non-UGA and are currently well vegetated. Most chinook-bearing stream miles (81.5%), and all known bull trout spawning-early rearing habitats, are within non-UGA lands (83% of the Tri-County area). A total of 23.9% of the Tri-County area would be covered by the more restrictive rural land management regulations, 17% would be covered by the urban regulations, and 59.1% is designated forest production land not under local jurisdiction.

6. INDIVIDUAL EFFECTS OF THE MODEL PROGRAMS

Chapter 6 analyzes the effects of individual Tri-County Model 4(d) Rule Response Proposal (Model) programs on various habitat characteristics important to chinook salmon and bull trout. The objective of this analysis is to assess whether individual Model programs would maintain or improve existing habitat conditions for chinook salmon and bull trout. The analysis relies on the results of the assessment of technical concepts presented in Chapter 4 and the sub-basin analysis in Chapter 5.

In this chapter, we test the consistency of each program (except the Regional Road Maintenance ESA Guidelines) with the municipal, residential, commercial, and industrial (MRCI) development limit of the National Marine Fisheries Service (NMFS) 4 (d) Rule for chinook salmon. The MRCI limit is presented in its entirety in Appendix E. Each of the individual Model programs is evaluated herein according to MRCI considerations.

Bull trout habitat requirements have been identified by the U.S. Fish and Wildlife Service (USFWS 1998) in their Interim Guidance document and by other publications reviewed in Section 4.2.1 of this biological review. Habitat requirements for bull trout spawning and early rearing are reasonably well identified. However, information on bull trout migration and foraging habitat is currently incomplete. Individual Model programs are evaluated herein according available bull trout habitat guidance and literature.

An analysis of the effects of the Model programs is presented in the following sections:

- 6.1 Stormwater Management Program Effects on PFC
  - 6.1.1 Peak Flows and Erosive Flow Durations
  - 6.1.2 Base Flows
  - 6.1.3 Temperature
  - 6.1.4 Sediment and Turbidity, Substrate
  - 6.1.5 Chemicals and Nutrients
  - 6.1.6 Physical Barriers
  - 6.1.7 Large Woody Debris
  - 6.1.8 Pool Frequency, Pool Quality, Width-to-Depth Ratio, Streambank Condition
  - 6.1.9 Off-Channel Habitat, Refugia, and Floodplain Connectivity
  - 6.1.10 Drainage Network and Road Density
  - 6.1.11 Disturbance History (Forest Cover)
  - 6.1.12 Riparian Reserves
- 6.2 Stormwater Management Program Consistency with MRCI Limit
  - 6.3.1 Stormwater Management Program MRCI Limit Conclusion
- 6.3 Land Management Program Effects on PFC
  - 6.3.1 Peak Flows and Erosive Flow Durations
  - 6.3.2 Base Flow
  - 6.3.3 Temperature
  - 6.3.4 Sediment, Turbidity, and Substrate
  - 6.3.5 Chemicals and Nutrients
  - 6.3.6 Physical Barriers
  - 6.3.7 Large Woody Debris
  - 6.3.8 Pool Frequency, Pool Quality, Width-to-Depth Ratio, Streambank Condition

6.3.9 Off-Channel Habitat, Refugia, and Floodplain Connectivity
6.3.10 Drainage Network and Road Density
6.3.11 Disturbance History (Forest Cover)
6.3.12 Riparian Reserves

6.4 Land Management Program Consistency with MRCI Limit
6.5.1 Land Management Program MCRI Limit Conclusion

6.5 WRIA Based Planning Program
6.6.1 WRIA Based Planning Program Conclusions

6.6 Monitoring and Adaptive Management Program
6.6.1 Monitoring Effectiveness
6.6.2 Definition of Roles and Responsibilities
6.6.3 Program Modification
6.6.4 Institutional Requirements for an Effective Program
6.6.5 Monitoring and Adaptive Management Program Conclusions

6.7 Habitation Acquisition and Restoration Funding Program
6.7.1 Funding
6.7.2 Spending Priorities
6.7.3 Reporting and the Dependability of Funding
6.7.4 Conclusions

6.8 Conclusions of Individual Effects of the Model Programs

6.1 STORMWATER MANAGEMENT PROGRAM EFFECTS ON PFC

Analysis of the Stormwater Management Program uses the NMFS and USFWS MPIs as a framework to evaluate the program's general effects on PFC. The matrix analysis in this chapter and Appendix D categorizes the biological outcomes of individual program elements (e.g., water quality source control) in the short and long term.

As discussed in Section 4.3.2, the Stormwater Management Program does not rely solely on these technical and land use standards to improve or maintain PFC. To help achieve its goals, the Stormwater Program also depends on and needs to include capital improvements, habitat acquisition and enhancement, and National Pollution Discharge Elimination System municipal stormwater permit-related programs (e.g., enforcement, reduction of illicit discharge, etc.). These additional actions would be identified, planned, and funded through the Stormwater Program planning element, and as needed through the Watershed Based Salmonid Conservation Planning (WRIA Based Planning), Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs.

Note Regarding Forest Practices and the Rural 65/10 Residential Site Standard: In rural areas, a key element of the Stormwater Program is the Rural 65/10 Residential Site Standard. Local jurisdictions do not regulate forest practices other than conversion of forest land to other uses (Chapter 2). The state and federal governments regulate timber practices, including the stormwater management aspects of those practices. For the reasons stated in Chapter 2, this analysis assumes that state and private forest practices conducted pursuant to the state's revised forest practices rules, as well as federal forest practices (and private forest practices on federal lands) conducted pursuant to ESA Section 7 consultations, will contribute to attaining and maintaining PFC for salmonid habitat in the Tri-County region.

Areas cleared under Forest Practice Permits would be replanted (with no impervious surface added). Replanted areas would retain forest soils, but seedlings or immature forest would not be expected to provide the same functional habitat value as mature forest, particularly with regard to shading, microclimate, large woody debris, and nutrient inputs. We have not assessed the magnitude of impacts that may occur if the state does not apply the Rural 65/10 Residential Site Standard to Tri-County areas under its jurisdiction.

6.1.1 Peak Flows and Erosive Flow Durations

Based on the evaluation described below, the combined effects of the Rural 65/10 Residential Site Standard in rural sub-basins (see Appendix B), infiltration/dispersion, and flow duration controls would be expected to maintain or improve peak flow conditions and the duration of erosive flows. In particular, improvement would occur because many sites are already cleared, and flow controls are required to match flow peaks and durations to site conditions that existed prior to any development in the Puget Sound region.

Application of the Rural 65/10 Residential Site Standard is projected to minimize or reduce the loss of native vegetation in rural sub-basins. Sixty five percent of existing forest cover would be maintained on residential sites where it currently exists. Where sites are currently 100% forested, the Rural 65/10 Residential Site Standard may allow deforestation of up to 35% of the site. For sites where less than 65% of forest cover remains, the Model requires that remaining forest be retained, while subdivisions are required to reforest to the 65% level. Wherever existing forest cover is retained, current levels of stormwater storage and release in organic soil layers, interflow, and infiltration would be maintained.

Full dispersion requires runoff to be spread through a substantial flow path of undisturbed native vegetation (100 ft or more). However, topography and other site constraints may make full dispersion impracticable on an unknown number of sites. Full dispersion of runoff from impervious surfaces, infiltration and dispersion BMPs, and infiltration facilities would help promote natural hydrologic processes such as interflow, infiltration, and groundwater recharge, thus reducing surface water runoff volumes and reducing increases in peak flows and erosive flow durations (see Section 4.3.2.1). The magnitude of the benefits would be uncertain on a watershed and regional scale due to site constraints and soil conditions that vary among sites. The effectiveness of dispersion and infiltration on a watershed and regional scale is uncertain and difficult to predict.

Section 4.3.2.3 describes how flow control facilities would be expected to control peak flows and the duration of erosive flows from new effective impervious areas (EIA). In areas where significant clearing or development has already occurred (>50% of Tri-Co. area), development and redevelopment activities with these facilities would reduce peak flows and durations because the flow duration standard is designed to match peaks flows and durations for site conditions that existed prior to any development in the Puget Sound region[32]. Some individual site development may, however, have new EIA below the threshold for requiring flow controls. These sites must still disperse and infiltrate stormwater to the maximum extent practicable. If a significant number of sites within a given sub-basin qualify for this exception, maintenance or improvement of peak flows and durations would rely on jurisdictions to implement regional facilities or other types of actions (e.g., regulatory/programmatic) through the stormwater planning element and capital improvement program element. Regional facilities operate

[32] The Model requires that facilities be designed to match the discharge durations for the site condition that existed prior to any development in the Puget Sound region. Absent information regarding the original site condition, the predevelopment condition must be assumed to be forested.

using the same principles as local facilities – using a control structure to regulate flows and providing storage volume for detained water – but on a larger scale. Regional facilities would be expected to be practicable and effective for improving or maintaining peak flows and durations (King County Capital Improvement Project Design Team 2000).

6.1.2 Base Flows

The Stormwater Management Program would be expected to allow degradation of base flows. However, elements of the stormwater program would reduce development impacts to infiltration for groundwater recharge, as described below.

The Rural 65/10 Residential Site Standard is projected to reduce loss of forest cover in rural sub-basins (see Appendix B). Where forest cover is retained, current levels of stormwater storage and release in organic soil layers, interflow, and infiltration would be maintained. However, the Rural 65/10 Residential Site Standard may allow some deforestation or other clearing of existing vegetation and therefore the loss of these functions. Where sites are already cleared, the potential for reforestation of a portion of the site would be maintained by the requirement to limit impervious surface area. For sites where less than 65% of forest cover remains, the Model requires that remaining forest be retained, while subdivisions are required to reforest to the 65% level.

The Model does not apply impervious area and forest clearing limits in urban sub-basins. The Model relies on other measures to be implemented through stormwater planning and CIPs, and the long-term programs to maintain or improve the functions provided by impervious area and forest clearing limits. We do not foresee that these other measures would effectively maintain or improve base flows. Section 4.3.2.1 describes how full dispersion of runoff from impervious surfaces, infiltration and dispersion BMPs, and infiltration facilities would promote natural hydrologic processes such as interflow and infiltration, and thus provide slow release of water to streams to maintain base flow. However, the magnitude of the benefits would be uncertain on a regional scale, due to site constraints and removal of native soils (however, soil amendment BMPs, required by the Model, would partially mitigate removal of native soils). Additionally, till soils, present in much of the Tri-County area, limit infiltration of water collected from impervious areas.

Efforts to reduce impervious surface and encourage use of low impact development BMPs, as proposed in the Stormwater Program land use decisions/regulations element, would also reduce losses in groundwater recharge and base flows to an uncertain extent.

6.1.3 Temperature

The Stormwater Management Program would contribute toward maintaining or degrading temperature[33], by maintaining or allowing degradation of groundwater recharge and base flows, through the effects of the elements described in Section 6.1.2 (base flows). Efforts to reduce impervious surface and encourage use of low impact development BMPs, as proposed in the land use decisions/regulations element, would contribute to maintaining temperature in the long term by increasing shade and infiltration, and limiting the construction of surfaces that absorb less heat.

[33] As noted in the beginning of this chapter, the effect of this program on temperature conditions would apply to both chinook salmon and bull trout.

6.1.4 Sediment, Turbidity, and Substrate

The Stormwater Management Program would contribute to maintaining sediment and turbidity and substrate conditions based on the elements discussed below.

The combined effects of the Rural 65/10 Residential Site Standard (in rural sub-basins; see Appendix B)[34], infiltration/dispersion, and flow duration controls (see Section 6.1.1) would be expected to prevent increasing durations of erosive flows. In areas where significant clearing or development has already occurred (>50% of Tri-Co. area), development and redevelopment activities implementing these facilities would reduce erosive flow durations because the flow duration standard calls for matching historic (i.e., forested) flow peaks and durations. Implementation of flow control facilities designed according to the duration control standard would be expected to reduce or maintain channel and streambank erosion and in turn reduce or maintain sediment and turbidity sources, thereby countering the effects described by Booth and Jackson (1997).

Water quality treatment would be expected to maintain sediment levels. As discussed in Section 4.3.2.7, water quality treatment facilities would control total suspended solids (TSS) to levels below which adverse effects to fish are likely to occur. Concentrations of suspended sediment that kill fish within a short period of time typically range from hundreds to thousands of milligrams per liter (Department of Fisheries and Oceans 2000). Sublethal effects to fish generally occur at suspended sediment concentrations in the tens to hundreds of milligrams per liter.

Improved inspection and maintenance of stormwater facilities would also reduce sedimentation from current levels. The Model and the Washington State Department of Ecology (Ecology) Manual update (Ecology 2001) require maintenance standards that are more stringent than stormwater system maintenance standards currently used by most jurisdictions. Maintenance will physically remove sediment from water quality and flow control facilities and conveyance systems, preventing it from reaching aquatic resources. In addition to removing sediment from the system, maintenance of flow control and water quality facilities will also ensure proper operation of the facilities to trap sediment and match flows as described above.

Assuming that the average aggregate area of active construction sites remains similar to current and recent levels, temporary erosion and sedimentation controls (TESC) would be expected to reduce instream sedimentation from current levels, thus improving gravel, pools, and water quality in jurisdictions where TESC is currently inadequate. Sediment loads from construction activities are projected to be reduced from current levels because the proposed TESC BMPs are improved over historic practices (i.e., with stricter design criteria). In addition, several BMPs have been added (not currently in use in most jurisdictions), including seasonal work limitations and clearing limits, which are more stringent than required by the previous version of the Ecology stormwater manual (Ecology 1992). Furthermore, formal TESC would be required for more sites; the site size requirement for construction NPDES Permits that would be reduced from the current threshold of 5 to 1 acres under NPDES Phase II[35].

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[34] The applicability of the sub-basin analyses is discussed in Section 5.4.

[35] National Pollutant Discharge Elimination System (NPDES) permits for construction activities are currently (under Phase I NPDES) required for construction sites 5 acres or greater. Smaller projects that are part of a common plan or action (e.g., subdivisions) whose cumulative area is greater than 5 acres are also required to obtain a permit. A key requirement of construction NPDES Permits is to develop a Stormwater Pollution Prevention Plan, which identifies the specific actions that would be taken to control erosion and sedimentation and other forms of construction-related pollution. NPDES Phase II, which will become effective in 2003, would require permits for sites of 1 acre or greater, which would provide permit coverage over a much greater total area.

The Model and the Ecology Manual update (Ecology 2001) require formal TESC plans for construction sites having new or replaced impervious surfaces 2,000 ft^2 or greater, whereas the previous Ecology Manual threshold was 5,000 ft^2, with single family homes exempted. Most construction projects would be covered under the new requirements. These increased TESC implementation requirements and improved practices would be expected to appreciably improve erosion and sediment control on a sub-basin scale, but would rely on additional jurisdictional requirements to control very fine sediment (and turbidity). BMPs sized for the 2-year flow would capture the majority of sediment, but would not control very fine sediment particles and turbidity (Ecology 2001). Advanced treatment is often necessary, particularly for wet season construction on large projects[36]. Because advanced treatment is only an option, not a requirement in the Model, prevention of turbidity impacts would rely on jurisdictions to provide detailed requirements regarding its use when applying for coverage.

6.1.5 Chemicals and Nutrients

The Stormwater Management Program would maintain or allow degradation of chemical and nutrient water quality conditions due to the elements discussed below.

As discussed in Section 4.3.2.7, water quality treatment would be expected to control metals to less than acutely toxic thresholds. Although this generally indicates that the level of treatment would be protective of acute effects, sufficient information is not available to determine if this treatment would be protective of sublethal effects. Scientific information on potential adverse sublethal effects is incomplete[37]. Long-term protection of water quality would rely on adaptive management and monitoring to incorporate new scientific information into treatment facility performance standards. The program would rely on the stormwater planning, capital improvement program, stormwater source control, and public education elements, as well as the WRIA Based Planning and Habitat Acquisition and Restoration Funding Programs to implement regional facilities and other actions (e.g., regulatory/programmatic) to account for treatment shortfalls where they are identified.

Scholz et al. (2000) found that concentrations of pesticides known to occur in Puget Sound lowland streams disrupt anti-predator responses and homing behaviors in chinook salmon. As described below, the Stormwater Program contains some elements that would be expected to reduce the effect of landscaping chemicals, but would ultimately rely on external programs. As discussed in Appendix B, the Rural 65/10 Residential Site Standard in rural areas is projected to reduce loss of forest cover[38]. This would help limit

[36] Advanced treatment consists of chemical or physical methods for removing particles that cannot be removed by conventional filtration or settling. As with any chemical operation, this introduces an additional risk. However, the standards for chemical treatment are sufficiently stringent to minimize the risk of harm to salmon and bull trout. Where advanced treatment uses chemicals (e.g., Seattle-Tacoma International Airport third runway in Sea-Tac, Microsoft expansion, and Redmond Town Center in Redmond), it is in very controlled situations, with oversight by Ecology and/or local permitting agencies. Oversight requirements include formal written approval by Ecology, inclusion in State Environmental Protection Agency (SEPA) review, review of treatment system plans and operating procedures, effluent monitoring, and effluent bioassays. Operators are required to have at least 40 hours of training. Treatment technologies typically use chemicals and proven technologies that have been used historically in applications such as potable water treatment (coagulation/flocculation and settling). Applications of treatment chemicals are typically more than an order of magnitude less than toxic thresholds.

[37] See Section 4.3.2.7. The acute threshold is considered to represent best available science for determination of toxicity because the typical exposure period for stormwater discharges is similar to acute conditions. In addition to toxicity, other potential adverse effects may occur such as sublethal effects, multiple acute exposures, accumulation in streambed substrate, or non-metals pollutants. .

[38] The applicability of the sub-basin analyses is discussed in Section 5.4.

the area of new managed vegetation in which fertilizers and landscaping chemicals are applied in rural areas.

The objectives of the public education element of the Stormwater Management Program include education to promote proper use and disposal of landscaping chemicals; however, public education would not be expected to substantially offset increases in chemicals applied to newly developed landscaped areas. The source control element also includes integrated pest management and lawn/vegetation management, but the source control BMPs are required only for multi-family, commercial, industrial, and government sites (not for single-family residential sites). Without specific regulations or programs to limit chemical use, the Model relies on external laws and programs to prevent water quality effects on salmonids due to pesticides. Washington State law prohibits pesticide applications that contaminate lands or water bodies, or harm people or desirable wildlife (WAC 16-228-12202), (3), (5)). The Washington State Pesticide/ESA Task Force, an interagency technical and policy team of scientists and managers from regional resource and regulatory agencies, has developed a strategy to evaluate the impacts of current pesticide use on threatened and endangered salmonids in Washington State. (Task Force 2001; WSDA Publication No. 057, Ecology Publication No. 01-10-058.) The screening process will identify which individual pesticides are or are not potential risks to the biological requirements of listed salmonids or their critical habitat in Washington State. The screening process will also facilitate ESA compliance for registered uses of pesticides in Washington State. As a result, the effect of pesticides on salmonids would be expected to decrease over time due to these and other efforts together with the Tri-County stormwater management program.

The source control certification element of this program requires local governments to train inspectors, perform regular inspections, and maintain records. A consistently applied source control program would be expected to minimize sediment, chemicals, and nutrient impacts from commercial, industrial, and multi-family sites.

The illicit discharge elimination element would continue to follow current practices to identify and eliminate discharges, thereby reducing chemical and nutrient pollution from these sources.

As stated above, improved TESC practices would be expected to reduce current levels of sediment loads from construction activity. As a result, nutrients bound in sediment would be reduced from current levels. The construction BMPs include control of non-sediment pollutants as well and, therefore, would be expected to control chemical runoff from construction sites. Improved maintenance of existing facilities would also improve control of chemicals and nutrients in runoff.

6.1.6 Physical Barriers

The Stormwater Management Program would contribute to maintaining habitat access for salmonids through the maintenance standards element by requiring jurisdictions to twice-annually inspect public culverts that have a history of maintenance-related fish passage problems. Inspection (and maintenance where necessary) of public culverts would be expected to maintain fish passage commonly blocked by debris. Maintenance of culverts would also contribute to maintaining transport of nutrients, sediment, woody debris, and other materials. Stormwater planning, CIP, and habitat enhancement/rehabilitation elements would also identify and remove fish passage barriers.

6.1.7 Large Woody Debris

The Stormwater Management Program is not intended to directly address large woody debris.

6.1.8 Pool Frequency, Pool Quality, Width-to-Depth Ratio, Streambank Condition

The Stormwater Management Program would contribute to maintaining or improving pool frequency, pool quality, width-to-depth ratio, and streambank conditions because of the combined effects of the Rural 65/10 Residential Site Standard (in rural sub-basins; see Appendix B), infiltration/dispersion, flow duration controls, water quality treatment, and temporary erosion and sediment controls. In particular, maintaining or decreasing peak flows and erosive flow durations (see Section 6.1.1) would be expected to maintain or decrease channel scour and erosion, and the resulting sedimentation in pools. The habitat enhancement/rehabilitation elements would also be expected to improve channel conditions.

6.1.9 Off-Channel Habitat, Refugia, and Floodplain Connectivity

The Stormwater Management Program would be expected to contribute to maintaining off-channel habitat, refugia, and floodplain connectivity if jurisdictions appropriately implement the land use decisions/regulations element in this program to protect these areas. The land use element and the Washington State Growth Management Act (GMA) require cities and counties to use best available science in designating and protecting critical areas when making comprehensive land use planning, zoning, and other land use decisions. Protection of off-channel habitat, refugia, and floodplain connectivity through this element would specifically rely on jurisdictions requiring identification and protection of these areas through the permitting process.

6.1.10 Drainage Network and Road Density

As with the elements discussed in Section 6.1.9, the Stormwater Management Program would be expected to contribute to maintaining or allowing degradation of drainage network and road density conditions. This outcome would rely on jurisdictions appropriately implementing the land use decisions/regulations element by establishing specific protocols for reviewing and approving new road construction.

6.1.11 Disturbance History (Forest Cover)

The Stormwater Management program would be expected to contribute to maintaining or allowing degradation of forest cover conditions. Mixed forest and mature evergreen forest on designated agricultural, forest production, and rural lands combined currently accounts for 44.9% of the total Tri-County region (Appendix C). This program does not address forest cover in urban-designated areas; similar forest cover types in urban-designated areas account for 1.9% of the total Tri-County area.

As demonstrated for the test sub-basins in Appendix B (each with less than 65% existing forest), the Rural 65/10 Residential Site Standard applied on a site basis would be expected to reduce the potential for loss of existing forest. For sub-basins with less than 65% existing forest cover, this standard would be expected to maintain current forest conditions, assuming that some reforestation[39] occurs on subdivisions in newly-protected unforested undeveloped areas. This would also offset loss of forest from reasonable use exceptions.

Reasonable use exceptions are expected to be minor, in most cases representing only a fraction of a percent of sub-basin area (see Appendix F). There are non-conforming lots that could qualify for

[39] Reforestation is defined here, for a particular area, as re-establishment and long-term protection of native trees, undergrowth, and natural soils. It may occur actively (planting and management of trees) or passively (natural re-growth).

reasonable use exceptions (in buffers) and/or qualify as stormwater exempt lots; they will not be able to meet vegetation retention standards. If such lots are congregated along a stream reach, reach effects (such as loss of continuity) could occur.

The Rural 65/10 Residential Site Standard does not require reforestation of cleared areas (with the exception of subdivisions). However, by limiting impervious area, it retains the potential to reforest cleared areas in the future. For sub-basins with more than 65% forest cover, the Rural 65/10 Residential Site Standard would be expected to result in a reduction in forest cover.

The Rural 65/10 Residential Site Standard does not apply to urban subbasins. Without clearing limits, additional loss of forest would be expected to occur. However, as stated above, urban forest cover accounts for only 1.9% of the Tri-County area.

6.1.12 Riparian Reserves

The Stormwater Management Program would be expected to contribute to maintaining riparian reserves (see Section 6.1.9) and would rely on jurisdictions to implement the land use decisions/regulations element in this program to protect these areas. The land use element and Washington State GMA require cities and counties to use best available science in designating and protecting critical areas when making comprehensive land use planning, zoning, and other land use decisions.

6.2 STORMWATER MANAGEMENT PROGRAM CONSISTENCY WITH MRCI LIMIT

The consistency of the Stormwater Management Program with the MRCI limit is summarized in Table 6-1. The MRCI limit is presented in its entirety in Appendix E.

Table 6-1. Analysis of Stormwater Management Program and MRCI Limit Evaluation Considerations

MRCI Limit Consideration	Addresses MRCI Considerations[a]	Discussion
1. Sensitive Areas	partially	The Stormwater Management Program includes clearing/grading review and development inspection and code enforcement elements. While these do not directly stipulate protective measures, review of clearing/grading plans, inspection of developing sites, and enforcement of codes are critical first steps to ensure that sensitive areas are protected from direct disturbance (e.g., clearing) and indirect disturbance (e.g., sedimentation). Also, the land use decisions/ regulations element of the Stormwater Management Program would be expected to address protection of sensitive areas based on "best available science."
2. Water Quantity/Quality	partially	As discussed in Section 6.1.1, the Stormwater Management Program would be expected to maintain or improve peak flow conditions and the duration of erosive flows. Improvement would occur because many sites are already cleared, and flow controls are required to match flow peaks and durations to site conditions that existed prior to any development in the Puget Sound region. As discussed in Sections 6.1.2 and 6.1.3, the Stormwater Management Program would be expected to allow degradation of base flows and temperature. The Rural 65/10 Residential Site Standard (in rural areas), full dispersion of runoff from impervious surfaces, infiltration and dispersion BMPs, and infiltration facilities would be expected to reduce loss of groundwater recharge and resulting base flow impacts, but would not prevent degradation.

Table 6-1. Analysis of Stormwater Management Program and MRCI Limit Evaluation Considerations (Continued)

MRCI Limit Consideration	Addresses MRCI Considerations[a]	Discussion
		As discussed in Sections 6.1.4 and 6.1.5, the Stormwater Management Program would be expected to contribute toward maintaining or improving sediment and turbidity and substrate conditions, and to maintain or degrade chemical and nutrient water quality. Clearing/Grading Review and Development Inspection and Enforcement are critical to ensure proper implementation of the 65/10, infiltration/dispersion, flow duration controls, water quality treatment, and construction erosion and sediment control elements. Development inspection and enforcement would also prevent (or mitigate) stream temperature impacts resulting from illicit cutting of vegetation in stream buffers.
3. Riparian Zones	partially	Clearing/grading review and the development inspection and code enforcement elements do not directly stipulate protective measures, but review of clearing/grading plans, inspection of developing sites, and enforcement of codes are critical first steps to ensure that sensitive areas are protected from direct disturbance (e.g., clearing) and indirect disturbance (e.g., sedimentation).
4. Stream Crossings	not intended	The Stormwater Management Program is not intended to address the Stream Crossings consideration as it is defined in the MRCI limit language.
5. Streambank Condition/CMZ	partially	As discussed in Sections 6.1.8 and 6.1.9, the Stormwater Management Program would be expected to contribute toward maintaining streambank and off-channel conditions.
6. Wetlands	partially	See Riparian Zone Consideration, above.
7. Peak Flow Conveyance	not intended[b]	The Stormwater Management Program is not intended to address Peak Flow Conveyance. This consideration determines whether conveyance is maintained in natural stream channels and at stream crossings.
8. Native Landscaping	partially	As discussed in Section 6.1.11, the Stormwater Management Program would be expected to contribute toward reducing the loss of forest cover conditions in rural areas. The Stormwater Management Program does not address forest cover in urban-designated areas. The Model does not encourage landowners to plant with native vegetation outside the MZ and 65% forest cover area.
9. Erosion/Sedimentation	substantially	As discussed in Section 6.1.4, the Stormwater Management Program's TESC element would be expected to effectively control sediment, because of improved practices and more stringent thresholds for formal TESC implementation. Control of very fine sediment and turbidity would rely on additional jurisdictional requirements for advanced treatment.
10. Water Supply	not intended	The Stormwater Management Program is not intended to address Water Supply (see Section 7.4).
11. Monitor/Enforce/Fund	Monitoring: partially Enforcement: substantially Funding: substantially	The Stormwater Management Program monitoring element requires a monitoring program consistent with the requirements of the Monitoring and Adaptive Management Program. However, as discussed in Section 6.6, the Monitoring and Adaptive Management Program does not provide specific regional protocols, or identify the process for establishing regional protocols.[c] Thus, there is no certainty that consistent and useful monitoring programs would occur across jurisdictional boundaries. Aside from the monitoring element, the Stormwater Management Program's development inspection and enforcement, clearing/grading review, stormwater facility inspection, and stormwater planning review elements would partially address this consideration, but would rely on jurisdictions to provide implementation details when applying for MRCI

Table 6-1. Analysis of Stormwater Management Program and MRCI Limit Evaluation Considerations (Continued)

MRCI Limit Consideration	Addresses MRCI Considerations[a]	Discussion
		limit coverage. The Washington GMA requires jurisdictions mandated to plan under GMA to use "best available science" which requires adaptive management (WAC 365-195-925(2).
12. State and Federal Laws	substantially	The Stormwater Management Program meets CWA/NPDES and Puget Sound Water Quality Management Plan requirements by incorporating practices that meet or exceed the requirements of the Ecology Stormwater Manual and Municipal NPDES Permits. Implementation certification by the Department of Ecology would provide external agency and public review to ensure that jurisdictions continue to comply with the CWA and the Puget Sound Water Quality Management Plan. GMA requires jurisdictions to periodically update plans and regulations to achieve the GMA and local policies (RCW 36.70A.130).

[a] **Substantially** = the Model or program appreciably addresses the consideration. **Partially** = the Model addresses a portion of the MRCI consideration but its overall performance against the consideration is not conclusive. **Not intended** = program is not intended to (and does not) address this consideration.

[b] MRCI consideration (G) states "MRCI development ordinance or plan adequately preserves the hydrologic capacity of permanent and intermittent streams to pass peak flows." The Stormwater Program does not address modifications to stream channels.

[c] NPDES Permits would require monitoring plans, but the NPDES Permit process does not appear to provide for *regional* monitoring protocols and coordination.

6.2.1 Stormwater Management Program MRCI Limit Conclusion

Implementation of the Stormwater Management Program (incorporating the Watershed Based Salmon Conservation Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs) partially meets the requirements of the MRCI limit. While this program addresses potential impacts associated with new development and construction of new stormwater discharges, it relies on other programs (most notably Land Management) to meet the MRCI limit. Existing habitat conditions, except for base flows, would generally be expected to be maintained through the Stormwater Management Program in the short term. In the long term, flow controls and stormwater CIPs would be expected to improve peak flows and durations; in turn, this would improve channel conditions. The Stormwater Management Program would allow continued development to degrade base flows.

The Stormwater Management Program may improve the distribution of chinook salmon and bull trout in the Tri-County region, particularly by improving fish passage conditions through the capital improvement programs and habitat enhancement/rehabilitation elements. This would make new habitat to the fish through this program. No water quality issues addressed by this program are known to currently restrict the distribution of the fish, so the program would not be likely to affect fish distribution through the water quality pathway.

6.3 LAND MANAGEMENT PROGRAM EFFECTS ON PFC

Management zone (MZ) regulations would generally be expected to appreciably protect existing mature riparian forest and currently immature riparian forest, allowing them to mature. For rural areas where riparian vegetation is thoroughly intact beyond the extent of the IMZ, the program would not protect existing conditions from degrading. In reaches where riparian areas are cleared but not developed, the program would gradually improve conditions over the long term as vegetation matures. The Model does not have provisions that require or encourage landowners to plant native vegetation outside the MZ and 65% forest cover, or to reduce water, herbicide, pesticide and fertilizer use, and lawn area. The program does not guarantee improvement of native vegetation on cleared but undeveloped areas within the MZ.

6.3.1 Peak Flows and Erosive Flow Durations

The Land Management Program would contribute to maintaining peak flows and erosive flow durations by preserving infiltration and dispersion in native riparian vegetation and soils. However, this effect would be commensurate with the proportion of sub-basin area contained within MZs.

6.3.2 Base Flows

By contributing to maintaining infiltration and dispersion (Section 6.4.1), the Land Management Program would contribute to maintaining base flows.

6.3.3 Temperature

The MZ regulations of the Land Management Program would generally be expected to contribute toward maintaining existing water temperatures in the short term, but may also contribute to improvement or degradation depending on the extent of existing riparian vegetation and the degree of base flow impacts. MZ regulations have the potential to improve water temperatures in the long term through the protection and eventual maturation of immature riparian forest inside and outside of the urban growth area (UGA), where it exists. Mature forest would provide additional shading necessary for improving stream temperatures. However, in heavily urbanized areas (UGA or non-UGA) with little existing functional riparian habitat, MZ regulations would have no effect on temperatures because the regulations would primarily maintain the existing poor riparian conditions, and flow regimes would continue to be affected by high concentrations of impervious area. As discussed in Section 5.4, 17% of the Tri-County area is designated UGA and 83% is designated non-UGA. Compared with the non-UGA area, the UGA is characterized by relatively degraded riparian vegetation and higher concentrations of impervious area. As the UGA is urbanized, concentrations of impervious area are expected to increase. Improvement of degraded shading and temperature conditions in these locations would rely on jurisdictions to identify these areas and implement riparian restoration projects through watershed planning and habitat restoration funding. Maintenance and long-term maturation of MZs would have relatively little effect on wider streams or rivers (e.g., Puyallup, Snohomish, and Middle Green Rivers, etc.) because shading from riparian vegetation has little or no controlling effect on their water temperatures (Chapter 4). New rural development controlled by the Rural 65/10 Residential Site Standard could allow some potential increase in water temperatures.

6.3.4 Sediment, Turbidity, and Substrate

The Land Management Program would be expected to contribute toward maintaining sediment, turbidity, and substrate conditions. At the local scale, in areas of unstable streambanks, allowing trees to mature would protect natural streambank integrity. Where streambanks are stable and young trees are present in the riparian zone, maturing trees would help maintain natural streambank integrity (maintaining an existing condition) and reduce channel erosion, sediment, and turbidity. The program would allow road and utility crossings on streams under 20 ft wide as a prescriptive allowed use with some restrictions; mitigation would be required for impacts caused by such crossings.

6.3.5 Chemicals and Nutrients

The Land Management Program would be expected to contribute toward maintaining existing chemical and nutrient water quality by maintaining biofiltration through riparian vegetation. MZs would be less effective at controlling chemicals and nutrients in existing developed or cleared areas (Appendix C provides information on land use characteristics for each sub-basin in the Tri-County area).

6.3.6 Physical Barriers

The Land Management program would be expected to maintain or improve habitat access. In previously developed areas, habitat access may be improved. The Program allows new instream structures only as part of a project approved by state or federal governments. Utility crossings and minor bridges are allowed under limited circumstances, and the latter are required to comply with Washington Department of Fish and Wildlife (WDFW) and NMFS fish passage guidelines. Stormwater management facilities are not allowed in streams. Conveyance facilities allowed in the MZ are required to include appropriate fish habitat passage features. Use of the habitat evaluation process (Chapter 4; Appendix H) requires evaluating the proposal against the Model's biological goals and habitat goals and objectives, which include unimpeded access and movement of salmonids in the water column. Construction of barriers to fish passage would be prohibited by the Land Management Program, as well as by existing state and federal law (e.g., RCW Ch. 77.55).

6.3.7 Large Woody Debris

The Land Management Program would be expected to maintain or improve the potential for large woody debris recruitment. In previously developed areas, large woody debris would be improved over time in portions of the area as redevelopment occurs. The program would also provide recruitment sources in the long-term, through protection of existing mature riparian forest and maturation of immature riparian forest. By protecting cleared but undeveloped areas, the potential for incremental natural reforestation would also be maintained. This improvement would occur in each jurisdiction adopting the Land Management Program MZ widths, but would vary greatly depending on existing riparian conditions and allowances for MZ width averaging. Frequently, MZ widths of one site potential tree height would not be achieved because of existing development or clearing. However, in the long term, existing forest would mature and improve some habitat functions. Existing uses may prevent re-growth of native vegetation in previously cleared areas, but the areas could not be developed in a manner that would prevent future restoration opportunities. Habitat functions on streams having abundant existing riparian forest and regulatory limitations for future development would greatly improve as the forest matures.

Stream reaches with little or no riparian forest, or high levels of development, maintenance or improvement of large woody debris, would rely on jurisdictions implementing WRIA Based Planning and Habitat Acquisition and Restoration Funding Programs to identify, funds, and implement regulatory, programmatic, and/or capital actions to improve riparian buffers and/or large woody debris to the channel.

6.3.8 Pool Frequency, Pool Quality, Width-to-Depth Ratio, Streambank Condition

The Land Management Program would be expected to contribute toward maintaining pool, width-to-depth ratio, and streambank conditions. As discussed in Chapter 5, protecting mature trees and allowing immature trees to mature would help maintain streambank stability (maintaining an existing condition) and reduce channel erosion, sediment, and turbidity. This program's maintenance or improvement of large woody debris conditions (Section 6.3.7) would also contribute toward maintaining these conditions, as large woody debris is a key element in formation and maintenance of pool and channel conditions.

6.3.9 Off-Channel Habitat, Refugia, and Floodplain Connectivity

The Land Management Program would maintain off-channel habitat, refugia, and floodplain connectivity by protecting from development impacts in CMZs, associated wetlands and steep slopes (with intact riparian buffers and without new constriction from dikes, revetments, bank hardening, etc.). This would allow streams to continue to migrate and create off-channel areas (protecting existing meander potential, thus maintaining an existing condition). Where riparian corridors are fragmented or disconnected from floodplain and historic CMZs, improvements would not be expected to be sufficient to bring about sub-

basin-scale improvement. There are no provisions that would provide for reforestation of previously cleared land. Salmonid access to currently unavailable habitat would not occur through this program, but it is assumed that access would be a priority of habitat-based capital projects.

6.3.10 Drainage Network and Road Density

The Land Management Program would contribute to maintaining the PFC indicator for road density and location. Specifically, the indicator considers whether roads occur in valley bottoms. The Land Management Program would discourage construction of new roads in valley bottoms by precluding development in MZs, although it does allow for stream crossings by roads and utilities. There would not be changes in existing roads through this program that would increase access to currently unavailable habitat.

The Land Management Program is not intended to directly address the extent of the drainage network.

6.3.11 Disturbance History (Forest Cover)

As discussed in Appendix M, the Land Management Program would generally minimize degradation of, or maintain, forest cover within MZs. This PFC indicator applies on a basin-wide scale. The Land Management Program applies only to the MZ (except for the Rural 65/10 Residential Site Standard prerequisite for implementing the rural MZ), and would not improve this indicator on a basin-wide scale. The fixed regulation MZs would not significantly increase the area of riparian reserves (Appendix M), but the quality of existing riparian vegetation and soils would increase in the long term. While increased development would cause some additional clearing within the MZ (limited by restrictions presented in Chapter 4 and Appendix G), the maturation of remaining forest would be expected to compensate for the cleared areas. However, the extent of additional clearing is unknown.

6.3.12 Riparian Reserves

The Land Management Program is expected to maintain riparian reserves at current levels in the short term, and maintain or improve riparian reserves in the long term, primarily due to the MZs. The Land Management Program fixed regulation MZs would not significantly increase the area or continuity of riparian reserves because there is no requirement to reforest previously cleared land within the inner management zone (IMZ) and outer management zone (OMZ). The overall effect of the MZ regulations would be a gradual loss of OMZ riparian vegetation while protecting existing IMZ vegetation (Appendix M). In the short-term, existing riparian conditions in the IMZ would generally be maintained. Protection, maturation, and improved quality of the existing riparian vegetation within the MZ in the long-term (i.e., 100 years) would likely improve many habitat functions (May 2000).

Habitat conditions would not be improved in highly developed, cleared land, or lands not covered by the Model unless riparian reforestation and other habitat restoration or mitigation activities are implemented. For example, a substantial portion of chinook-bearing stream length is located in sub-basins having agricultural land use designations. According to the Tri-County Database (2001a), approximately 19.4% (228 of 1174 miles) of the total chinook-bearing stream miles in the Tri-County region are bordered by designated agriculture on either one or both streambanks. This area is distributed among 43 of the 159 Tri-County sub-basins. The number of agriculture bordered chinook-bearing stream miles ranges from 0.03 (Allen Creek) to 31 miles (Lower Mainstem Skykomish). Habitat Acquisition and Restoration Funding would be necessary to improve previously degraded habitat in these areas.

6.4 LAND MANAGEMENT PROGRAM CONSISTENCY WITH MRCI LIMIT

The consistency of the Land Management Program with the MRCI limit is summarized in Table 6-2.

Table 6-2. Analysis of Land Management Program against MRCI Limit Evaluation Considerations

MRCI Limit Consideration	Addresses MRCI Considerations[a]	Discussion
1. Sensitive Areas	partially	The Land Management Program requires that sensitive areas such as unstable or steep slopes, wetlands, and springs, where they exist, be included within the IMZ. No development activities are allowed within the IMZ except as specified in the Model. Development activities include any cutting or clearing of vegetation, construction, development, earth movement or other site disturbance of the land. The IMZ, which encompasses sensitive areas if present, shall be permanently placed in a separate protected tract such as a conservation easement and use restrictions shall be recorded against the title of the subject property with the county auditor. The Land Management Program does not address sensitive areas outside the MZ.
2. Water Quantity/Quality	partially	As discussed in Sections 6.3.1 and 6.3.2, the Land Management Program is not intended to appreciably address peak flows or base flows. As discussed in Sections 6.3.3, 6.3.4, and 6.3.5, the Land Management Program would generally be expected to contribute toward maintaining existing temperature, sediment, turbidity, chemical, and nutrient water quality conditions, but could improve conditions or allow degradation.
3. Riparian Zones	partially	As discussed in Section 6.3.12, the Land Management Program is expected to maintain riparian reserves at current levels in the short term and maintain or improve riparian reserves in the long term, primarily due to the MZs. However, the regulations do not ensure protection of riparian vegetation out to 1-SPTH (site potential tree height) from the CMZ[b].
4. Stream Crossings	partially	The Land Management Regulations seek to limit stream crossings. A stream crossing is only allowed if there is no other practicable alternative with less impact on riparian habitat or to the listed species. The crossing must allow for uninterrupted movement of wood and gravel. Bridges must be designed according to WDFW and NMFS guidelines. Mitigation is required for all impacts.
5. Streambank Condition/CMZ	partially	As discussed in Section 6.3.8, the Land Management Program would be expected to contribute toward maintaining pool, width-to-depth ratio, and streambank conditions. The Land Management Program does not address erosive flows, however. As discussed in Section 6.3.9, the Land Management Program would be expected to maintain off-channel habitat, refugia, and floodplain connectivity by protecting CMZs.
6. Wetlands	partially	See Sensitive Areas consideration No. 1 in this table. the MRCI limit related to "isolated wetlands" is not specifically address by the MZ model
7. Peak Flow Conveyance	partially	Adequate protection of riparian MZs provides protection of the natural hydrologic capacity by preserving CMZs, natural stream processes and functions. No new or expansion of permanent streambank stabilization, erosion hazard protection, or flood protection structures that might increase water velocities, flood potential, and channel erosion are authorized under the Land Management regulations or program.

Table 6-2. Analysis of Land Management Program Against MRCI Limit Evaluation Considerations (Continued)

MRCI Limit Consideration	Addresses MRCI Considerations[a]	Discussion
8. Native Landscaping	partially	As discussed in Section 6.3.11, the Land Management Program would be expected to contribute to maintaining forest cover within MZs and would effect forest retention outside of rural MZs through the Rural 65/10 Residential Site Standard.
9. Erosion/Sedimentation	partially	As discussed in Section 6.3.4, the Land Management Program would be expected to contribute to protecting and incrementally improving natural streambank integrity (reduction in erosion and sedimentation would also depend on control of erosive flows through the Stormwater Management Program).
10. Water Supply	not intended	The Land Management Program is not intended to address the water supply criterion.
11. Monitor/Enforce/Fund	partially	Under the Model, implementation of the Land Management Program also requires implementation of the Monitoring and Adaptive Management Program, Habitat Acquisition and Restoration Funding, and WRIA Based Planning Programs. Implementation of these three long-term programs to address watershed-scale riparian buffer conditions would rely on jurisdictions demonstrating how they would be implemented. The Washington GMA requires jurisdictions mandated to plan under GMA to use "best available science" which requires adaptive management (WAC 365-195-925(2).
12. State and Federal Laws	substantially	The Land Management Program regulations explicitly state that adoption of the Program does not alter the requirements to comply with all other applicable local, state, and federal environmental and natural resources laws and regulations without exception. GMA requires jurisdictions to periodically update plans and regulations to achieve the GMA and local policies (RCW 36.70A.130).

a **Substantially** = the Model or program appreciably addresses the consideration. **Partially** = the Model addresses a portion of the MRCI consideration but its overall performance against the consideration is not conclusive. **Not intended** = program is not intended to (and does not) address this consideration.

b The SPTH varies depending on soil conditions, elevation, and a variety of other factors. In the rural area, the land management regulations would allow clearing of the outer 50 ft of the MZ, resulting in only a 150 ft buffer. This is on the low end of SPTH in the region. In the urban area, the land management regulations would allow clearing as much as 65 ft of the OMZ. Depending on where this clearing occurs, there could be as little as 115 ft of buffer, which is less than the SPTH for most of the Puget Sound lowland region.

6.4.1 Land Management Program MCRI Limit Conclusion

Implementing the Land Management Program, and incorporating WRIA Based Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs, partially meets the requirements of the MRCI limit. While this program substantially addresses potential development impacts within riparian zones, it would rely on other programs (most notably Stormwater Management) to contribute to the maintenance or improvement of PFC and to meet the MRCI limit on a watershed scale. Synergistic effects of implementing all model programs are discussed in Chapter 7. Implementation of the Land Management Program is likely to contribute to the maintenance of PFC (where these conditions currently exist) through riparian buffers and retained forest cover, as well as through mitigation for allowed uses and reasonable-use exceptions. The Land Management Program is not likely to have a demonstrable adverse effect on the distribution of salmon and bull trout in the Tri-County region, nor is additional habitat is likely to become available to chinook salmon and bull trout through implementation of this Model program in the short term.

Where riparian vegetation is cleared but not developed, the Land Management Program would gradually improve conditions over the long term as developing vegetation is not removed. By protecting these areas, the regulations would also protect future recovery opportunities (e.g., natural and managed reforestation, in-stream and off-channel restoration, etc.). Some conditions would improve as the MZ vegetation matures, however, conditions such as sediment/turbidity, base flow, etc., are not likely to substantively improve as vegetation matures because of other urban development impacts.

6.5 WRIA Based Planning Program

The WRIA Based Planning Program includes a well-defined process and 5-year timeline for development of WRIA plans, including submittal of the plans to the Services for comment and approval for those cases where a jurisdiction seeks a take limit or other assurances under a 4(d) rule. This collaborative, strategic approach would identify, prioritize, and implement near- and long-term salmonid conservation and recovery actions. These aspects of the program provide the means to incorporate current knowledge and understanding of habitat requirements for salmonids into future actions taken under the Model. This process also provides the means for a direct connection between habitat actions and salmonid recovery.

WRIA based planning identifies feasible actions for the near-term, together with planning for long-term actions. This process provides the means to initiate immediate action where feasible, and incorporate results derived from the Monitoring and Adaptive Management Program, to guide habitat improvement through future actions.

The Tri-County Framework for WRIA planning identifies 10 elements that provide consistency in the implementation of watershed planning. The science-based assessment, monitoring, adaptive management, public involvement, and prioritization elements of this program are likely to support effective restoration actions over both the short and long term. Stakeholder (Tribal, state, federal, and other) involvement in the planning process is likely to guide actions that would improve habitat supporting salmon and bull trout. These groups conduct research and provide technical expertise appropriate for guiding effective habitat restoration.

The WRIA based planning framework and a watershed assessment framework developed by Tri-County Coalition and submitted to the Services for approval would be expected to define:

- The necessary content of WRIA plans, including interim guidance for identifying and prioritizing salmon conservation actions, and
- The common parameters that all watershed assessments must address, including acceptable analytical methodologies.

In those jurisdictions seeking a take limit or other assurances under a 4(d) rule, watershed plans developed by WRIA groups would be submitted to the Services for approval. The plans would be adopted, funded, and implemented by local governments and other implementing entities within the watershed. If response or approval is not received from the Services within 90 days of plan submittal, implementing entities may proceed to implement all or part of the plans pending response from the Services. The response deadline would help ensure that early action opportunities are not delayed. WRIA plans would be expected to be action-oriented, science-based, and linked to the Stormwater Management, Monitoring and Adaptive Management and Habitat Acquisition and Restoration Funding Programs.

Successful implementation of WRIA based planning would rely on: (1) jurisdictions identifying and maintaining their commitment to the WRIA group when applying for the MRCI limit, and (2) reporting of monitoring results to the Services as committed in the WRIA Based Planning Program. A successful

WRIA based planning process would provide guidance to the Land Management, Habitat Acquisition and Restoration Funding, and Monitoring and Adaptive Management Programs. It would function as an important element of the Adaptive Management Program by providing scientific information on the effectiveness of measures to improve habitat as well as needed changes in policy and technical programs to enhance effectiveness. Watershed planning would also provide information and an opportunity for stakeholder participation in future modification of the Land Management, Stormwater Management, and Regional Road Maintenance Programs through informed recommendations to the Tri-County Coalition.

6.5.1 WRIA Based Planning Program Conclusions

Watershed planning through the WRIA process is an effective vehicle to guide actions that would produce habitat improvement and protection. Combined with the Monitoring and Adaptive Management Program, this program has the potential to guide effective actions to contribute toward improvement of PFC where it does not currently exist and protect of PFC where it does exist. It also offers the potential to improve distribution of the listed species in historic habitat where they are not currently present. The success of these planning efforts depends on the participants and the commitment of the jurisdictions to habitat restoration. This program offers stakeholders the opportunity to provide information and guide efforts that would improve PFC and historic distributions of salmon and bull trout. The program cannot provide certainty in the number of participating jurisdictions and details of the planning scope. Effectiveness monitoring and reporting and adaptive changes would be necessary to ensure the performance of this program.

6.6 MONITORING AND ADAPTIVE MANAGEMENT PROGRAM

The Monitoring and Adaptive Management Program requires monitoring to be scientifically designed and focused to provide direct evidence of the effectiveness of management actions in both institutional and biophysical environments. The program requires critical policy decisions to be formulated as hypotheses for each 4(d) Rule program and watershed plan. Monitoring information would be used to evaluate actions and revise those that are not achieving desired outcomes in the expected timeframe. Based on results of effectiveness monitoring and recommendations from technical advisors who possess appropriate scientific expertise, policy oversight/guidance committees would make recommendations to local jurisdictions on where to intervene strategically to correct actions as necessary.

The Monitoring and Adaptive Management Program was analyzed relative to its stated objectives:

- To increase knowledge of ecosystem processes and functions .
- To clearly define roles and responsibilities of participants.
- To gather and evaluate relevant information and use appropriate quality controls to evaluate management decisions.
- To ensure that institutional course corrections are made as necessary to meet specific, measurable recovery goals and habitat objectives.
- To improve institutional environments to protect and restore ecosystem functions and processes as necessary.

Restoration and protection of ecosystem functions and processes is the ultimate objective of the Monitoring and Adaptive Management Program. For the program to contribute to this last objective, it was assumed that each of the preceding objectives must be achieved.

This Program recognizes that the state of knowledge of habitat requirements for chinook salmon and bull trout is inadequate. This is especially true for the Puget Sound lowland stream and estuarine habitats

where the Model would be applied. The Program would assist in developing additional information to guide future actions to maintain and improve salmonid habitat.

6.6.1 Monitoring Effectiveness

The Model provides for implementation/compliance, effectiveness, and validation/recovery monitoring to be conducted at appropriate scale and geographic range.

Implementation/compliance monitoring would confirm whether actions have been taken in the time and manner specified. The model provides for jurisdictions to report to the Services every 2 years. Effectiveness monitoring would be conducted strategically to measure whether specific policy decisions (structured as hypotheses, as outlined above) are achieving specified habitat objectives. Validation/recovery monitoring would focus on whether the region's actions, as a whole, provide a long-term trajectory to support overall recovery of salmonids. The adaptive management approach is also mandated by the Washington State GMA program for "best available science" in a situation where there is an absence of valid scientific information or incomplete scientific information (WAC 365-195-920(2)).

Most objectives, responsibilities, and reporting mechanisms of monitoring plans are clearly stated. However, the Monitoring and Adaptive Management Program does not provide specific protocols nor does it identify the process by which regional protocols would be established. For example, NPDES Permits under the Clean Water Act would require monitoring plans, but the NPDES Permit process does not appear to provide for regional monitoring protocols and coordination.

The Washington State Independent Science Panel (Currens 2000) recommends that existing monitoring programs either need to be: (1) significantly changed, linked, and coordinated with new program elements to achieve a comprehensive monitoring program, or (2) a new program must be developed. The Panel notes that both of these would require increased and stable levels of funding and policy commitments.

The difficulty in establishing an effective monitoring program should not be underestimated. In the area of wetland enhancement and replacement, which enjoys several decades of scientific experience, two recent studies indicate a significant lack of effective monitoring. For example, King County implements a regulatory framework that requires monitoring programs secured by performance bonds held for 3 to 5 years. However, a study in King County indicated 79% of sites investigated were not successful in meeting performance standards (Mockler et al. 1998). A similar study by the Washington State Department of Ecology found 29% of compensatory wetland mitigation projects meet performance standards. Roni et al. (2002) recently concluded that existing research and monitoring is inadequate to assess restoration techniques in Pacific Northwest watersheds.

This Monitoring and Adaptive Management Program is also unclear about how monitoring of individual 4(d) programs by jurisdictions would be integrated to meet the program's criterion that "the region's actions, as a whole, provide a long-term trajectory to support overall recovery of salmonids." This would be an extensive integrate the monitoring of many programs. In the absence of another structure, this role presumably would fall to NMFS and USFWS as the agencies ultimately responsible for recovery. It is unclear whether NMFS and USFWS have the staff resources to perform this role.

6.6.2 Definition of Roles and Responsibilities

Roles and responsibilities of jurisdictions implementing the Model are generally defined. The Regoinal Road Maintenance ESA Program provides very clear and specific definition. The other programs are less precise, but generally appear to be adequate to guide implementation.

The Monitoring and Adaptive Management Program identifies committees and planning bodies and their general makeup. As with monitoring protocols, because this is a regional program, it requires a commitment of resources for each jurisdiction as well as each state and federal agency, in terms of number and technical expertise of staff (or funding thereof). The proposed dispute resolution mechanism, including informal mediation or formal arbitration, likely could not bind NMFS and USFWS, which must maintain the ability to enforce the ESA.

6.6.3 Program Modification

Statement of policies as hypotheses would provide specific, measurable goals. However, the success of monitoring plans would rely on jurisdictions to identify triggers (level of non-attainment), procedures, responsibilities, and schedules for implementing course corrections. The mechanism to assure that correction activities are implemented is again left unspecified. In the absence of other mechanisms, the Services again would seem to be the final decision-maker regarding the need to change local programs to maintain formal 4(d) take limits or assurances in the face of new scientific information resulting from adaptive management programs. This issue is likely to be significant for the Land Management Program of the Model, which would require local jurisdictions to legislatively amend local land use regulations. This could place local elected officials in the center of perceived conflicts between regional resource needs and local interests, and involve complex property rights issues.

6.6.4 Monitoring and Adaptive Management Program Conclusions

The Monitoring and Adaptive Management Program is an essential element to ensure that progress is made toward improvement of habitat in previously degraded areas and maintenance of habitat in developing areas. The program, as established, has the capacity to meet this goal. The link to the WRIA Based Planning Program, and stakeholder involvement in implementation of the program, provides assurance that the program is likely to meet its intent. Recovery of salmon and bull trout within the Tri-County region can be supported through the Monitoring and Adaptive Management Program, which would provide information and guidance to future actions.

The role of adaptive management is clearly included in the Model, however the process for achieving adaptive management is not. Monitoring is established in a manner that is likely to formulate and test hypotheses resulting in new information available for modification of policies under adaptive management. However, a process for routine incorporation of this new information into appropriate policy revisions is not explicit in the Model. The Regional Road Maintenance ESA Program is more explicit than other Model programs in this regard, as it provides specific requirements to monitor BMP effectiveness and update BMP design standards, if necessary. Institutional course corrections would provide progress toward specific, measurable recovery goals and habitat objectives. The program would encourage, but not ensure, that institutional environments are improved, as necessary, and progress towards protection and improvement of ecosystem functions is made. Jurisdictions would need to specify a process for routinely incorporating new information into appropriate policy revisions.

6.7 HABITAT ACQUISITION AND RESTORATION FUNDING PROGRAM

The Habitat Acquisition and Restoration Funding Program is a key Model program for salmonid recovery in the Tri-County region. This program is an essential component for ensuring Model contribution toward salmon recovery. This analysis relies on several spending scenarios to gauge the potential contribution of the funding program toward improving salmonid habitat in the region. The analysis was performed according to the processes described in Section 3.6.3 and the discussion below. Assumptions in this analysis include 1) full participation by all Tri-County jurisdictions, and 2) funding and restoration-acquisition costs equally affected by inflation over time

This analysis of the Habitat Acquisition and Restoration Funding Program is intended to answer three questions:

- Would the funding level proposed be adequate to make meaningful progress towards salmon recovery?
- Would the funding be used to accomplish identified recovery needs?
- Would there be assurances in place to ensure that funding is sustained over time?

6.7.1 Funding

This analysis was conducted to: calculate the total funding that would be available for acquisition and restoration in the Tri-County area under the Program, determine the funding need in a selected watershed, predict habitat benefits associated with this funding, and judge whether these benefits are sufficient.

The total funding level and likely funding level by watershed were calculated as follows:

- The annual Tri-County 1% commitment of total capital budgets, as proposed in the Model, was calculated at the watershed level for Tri-County WRIAs 5 (Stillaguamish), 7 (Snohomish), 8 (Cedar-Sammamish), 9 (Duwamish-Green), 10 (Puyallup-White), and 11 (Nisqually). The capital budgets of jurisdictions within these WRIAs were obtained from the Washington State Auditor[40].
- The total funding level was assumed to be allocated by watershed proportionate to geographic area to estimate the potential funds available in each watershed for salmonid restoration.

The benefits of this funding level in a selected watershed were predicted through the following process:

- WRIA 9 was selected for analysis because it had the most complete information about restoration needs and costs, and because Chapter 5 of this biological review includes a detailed analysis of sub-basin conditions in WRIA 9. Project lists from reports prepared by the U.S. Army Corps of Engineers (2000), Seattle Salmon Team (2001), and WRIA 9 (2001) were assumed to constitute most habitat protection and restoration needs in the watershed – in lieu of a WRIA 9 Conservation Plan (see Chapter 2 discussion of watershed based conservation planning). In this analysis, it was assumed that restoration costs taken from these sources were adjusted for inflation.
- The WRIA 9 share of total annual Tri-County funding was compared with the total costs of completing these projects (both annualized and total costs) to determine what could be accomplished under the Habitat Acquisition and Restoration Funding Program over time.

Analysis of Funding Adequacy

The Habitat Acquisition and Restoration Funding Program commits a participating jurisdiction to 1% of its capital budget each year for funding habitat improvement and acquisition projects. Capital budgets were available for 61 of the 85 jurisdictions in the Tri-County from the State Auditor's Office in 2000. Capital budgets were not available for the remaining 24 jurisdictions because they either do not have a capital budget, their capital spending is funded by another source, or for some other financial reason.

One percent of the capital budgets included $1,341,039 for 12 of the 24 jurisdictions in Pierce County, $11,804,959 for 33 of the 40 jurisdictions in King County, and $1,933,684 for 16 of the 21 jurisdictions in Snohomish County for a total of $15,079,682 per year from these Tri-Counties jurisdictions (Washington

[40] The funding commitment was not adjusted for inflation; capital funds provided annually from each jurisdiction would reflect current rates of inflation.

State Auditor 2002). Since capital budgets were available for only 72% of the jurisdictions, the actual amount is higher. Although most of the non-reporting jurisdictions are small, with several exceptions (i.e., Bothell), the total amount of funding potentially available could be as high as $19,301,992, or at least within this range, if the published amount is increased by 28% to account for all jurisdictions.

Total available funding was allocated in proportion to the geographic area of each of the six watersheds in the Tri-County area. Because WRIA 9 (Green/Duwamish) had the most complete information on restoration needs and costs (in lieu of WRIA Conservation Plans), it was selected for analysis. Approximately $2,046,011 or 10.6% of funding was estimated to be available each year for WRIA 9 (Table 6-3).

Table 6-3. Funding Allocation by Watershed

Watershed	Acres	% Area in Tri-County	Total Portion of 1% Annual Funding
WRIA 5 – Stillaguamish	437,760	12.9	$2,489,957
WRIA 7 – Snohomish	1,187,840	35	$6,755,697
WRIA 8 – Cedar-Sammamish	442,880	13.1	$2,528,561
WRIA 9 – Duwamish-Green	358,400	10.6	$2,046,011
WRIA 10 – Puyallup-White	681,600	20	$3,860,398
WRIA 11 – Nisqually	285,045	8.4	$1,621,367

Washington State Auditor 2002; calculations by Tri-County staff.

WRIA 9 Restoration Costs in Relation to Estimated Funding

The projected cost of restoration was determined for WRIA 9 to test the potential benefits from the proposed Tri-County funding commitment. Restoration costs were derived from three restoration plans developed for WRIA 9. These plans are not comprehensive; however, they are used for the purposes of this analysis in lieu of a WRIA 9 Watershed Conservation Plan (anticipated to be completed in 2005)[41]. Each plan includes estimated restoration costs (Appendix J). Salmonid recovery project costs identified in the plan titled *Green/Duwamish River Basin Ecosystem Restoration Study* (King County 2000) totaled $115,879,400 (the estimated federal share is $75,321,610 and non-federal sponsor share is $40,557,790). The *Preliminary Draft Near-Term Action Agenda for WRIA 9* (2001) projects totaled $3,045,000, and the *Seattle's Urban Blueprint for Habitat Protection and Restoration* (Seattle Salmon Team 2001) project costs totaled $1,351,000. These plans represent a total cost of $120,275,400 or $44,953,790, when excluding the estimated federal government share of the *Green/Duwamish River Ecosystem Restoration Study* project costs. The plans address salmonid restoration projects for Elliott Bay, the Lower, Middle, and Upper Green River, and the Duwamish River basin. A complete list of sources examined for other WRIAs is provided in Appendix J, however, for the reasons discussed above, these WRIAs were not selected for this analysis.

The costs for WRIA 9 projects are presented to provide a basis for gauging the contribution of the Model funding program toward protecting and improving salmonid habitat in the Tri-County area. In this example, the Tri-County Funding Program ($2,046,011 per year) would cover 4.5% of the total, non-federal annual restoration costs in WRIA 9. If the federal share of the funding need is met, the Tri-County

[41] This analysis did not determine the appropriateness of using the three existing WRIA 9 plans as a surrogate for a WRIA 9 Conservation Plan (comprehensive restoration need). Nor did this analysis evaluate the criteria applied in prioritizing restoration actions.

funding program could complete the WRIA 9 restoration plans in approximately 22 years[42]. As such, the Program would help to support the expeditious completion of WRIA 9 restoration plans. However, if the federal funding share is not provided, the Program could complete the restoration plans in approximately 58 years. Matching funds would accelerate the time frame for completing WRIA 9 restoration plans.

Findings on the Adequacy of Funding

- Assuming that all Tri-County jurisdictions participate in the proposed program, nearly $20 million per year would be available for habitat acquisition and restoration across the Tri-County area.
- If funding was allocated proportionately by watershed area, each watershed would receive at least $1.6 million per year for habitat projects.
- The application of funding in the selected watershed, WRIA 9, would allow the completion of currently identified habitat projects in 22 years (provided that state and federal matching funds are available, funding is allocated to the recommended projects.

6.7.2 Spending Priorities

As discussed in Chapter 2, the Model proposes two phases for the implementation of the Program in which allocation of funding would differ. In phase one, from program inception to the completion of watershed conservation plans, participating jurisdictions pledge to be informed by the emerging plans in selection of funded projects. In phase two, following completion of the plans, jurisdictions commit to being consistent with the plans.

The determination on whether phase one spending will be appropriately focused on recovery needs was based on current and predicted capital funding and associated habitat improvements in Tri-County jurisdictions. The data used for the analysis is from Salmon Habitat CIP as a Percentage of Total CIP (King County CIP Design Team, 2000).

The determination on whether phase two spending will be appropriately focused on recovery needs was made by evaluating SRFB grants to Tri-County WRIAs for the period 1999-2000. This analysis assumed that SRFB spending represents the potential priorities of the watershed jurisdictions acting consistent with the emerging WRIA conservation plan.

As discussed in Chapter 2, monitoring of results and adaptive management would be used to refocus habitat funding over time. These mechanisms would be used to respond to new information about salmonid habitat requirements and to address residual land use impacts that are not addressed by other Model programs. WRIA based planning processes would provide guidance for monitoring and adaptive management efforts in phases 1 and 2.

Analysis of Spending Priorities

During phase 1, local spending would not be guided by WRIA plans (while the plans are being developed). Tri-County prepared an analysis of anticipated salmon funding in the 2001-2005 budgets for the three counties and the City of Seattle (King County CIP Design Team, 2000). Jurisdictions have the discretion to allocate funding to category 1 projects (projects that specifically benefit salmonid habitat and

[42] This analysis assumes that local jurisdiction's capital budgets and identified restoration plan project costs will be equally affected by inflation over time. These analyses must be refined by jurisdictions and watershed planning entities during implementation.

are likely guided by near-term WRIA based planning processes), category 2 projects (projects that provide mixed salmonid and non-salmonid benefits and are likely guided by individual jurisdictional capital priorities), or some combination of these project categories.

For example, the Tri-County analysis demonstrated that King County spending on salmon benefits associated with capital improvement projects on roads could exceed $8 million per year from 2001-2005. Assuming that King County chose to credit this funding towards its 1% commitment, the County's commitment under the proposed Program would be fulfilled. There is some incentive to fund category 2 projects during the phase one period as multiple funding needs could be addressed simultaneously. The biological benefits of road projects and other public works construction (category 2 projects) could be limited to the project site or its immediate proximity. Given that these sites are scattered across the Tri-County area and potentially chosen without regard to habitat benefits, the improvements to salmon habitat could be dispersed. While they will undoubtedly have some benefit to salmon habitat, these projects may not make a significant contribution to salmon recovery due to their location and association with major construction activity. Category 2 projects could provide greater benefit if guided by the fish-friendly ranking principles for capital improvement projects included in the Stormwater Program. Category 1 projects that have been strategically prioritized through near-term WRIA based planning processes would likely provide greater habitat benefits to salmonids.

In phase two, it is expected that the results will emulate the WRIA priorities demonstrated in the Salmon Recovery Funding Board (SRFB) process. The SRFB and local project sponsors worked collaboratively to prioritize projects according to scientific data and what is known of habitat needs. Together they provided a total of $32,057,840 ($19,631,577 and $12,426,263, respectively) for salmonid recovery projects in the Tri-County region in 1999-2001.

The SRFB allocated approximately 55% of annual funds to habitat acquisition, 30% to capital intensive restoration such as barrier removal, culvert replacement and restoration), and 15% to studies, planning, and monitoring. If the estimated $19,301,992 in annual Tri-County funds were allocated accordingly (across the landscape), a total of approximately $10,616,095 would be allocated to acquisitions, $5,790,597 would be allocated to restoration, and $2,895,298 would be allocated to studies, planning and monitoring.

The SRFB data were also used to assess the potential contribution of the funding program toward achieving specific kinds of restoration (i.e., habitat benefits). The SRFB data provided a per acre cost of $35,959 per acre for salmonid habitat acquisition in the Tri-County area (*SRFB Funding in the Tri-County Area by Project Type*, 1999-2001). Assuming that Tri-County jurisdictions allocate 55% of annual funding to acquisition (as calculated above) and acquisition costs remain constant, the Tri-County funds could purchase approximately 295 acres of salmonid habitat per year. The actual acres purchased would vary due to inflation and property location, since property values are generally higher in urban than rural locations. According to this analysis, the Program could make a significant annual contribution to habitat acquisition, similar in magnitude to the contribution of the SRFB (without local matching).

Findings on Spending Priorities

- During phase one, funds generated by the Program could be dedicated to category 1 projects, category 2 projects, or some combination thereof. While of local benefit (particularly if guided by fish-friendly capital project ranking principles – such as those included in the Model's Stormwater Program), category 2 projects could be limited in their contribution to watershed and regional salmon recovery.
- During phase two (guided by WRIA conservation plans), funding could mimic watershed priorities demonstrated in the SRFB funding program to date. The SRFB demonstrates a strong commitment to collaborative decision-making and influence of science in prioritization of

projects among the jurisdictions. As such, the Program could make a significant contribution to meeting acquisition, restoration, and planning needs.

- It is assumed that jurisdictions would respond to new information about salmonid habitat requirements and residual land use impacts (that are not addressed by other Model programs) through WRIA based planning processes – in phases 1 and 2. See additional discussion in Section 6.6.3.

6.7.3 Reporting and the Dependability of Funding

The Tri-County Funding Program requires that each jurisdiction produce an annual report to the Federal Services (if a formal NMFS take limit or reduction or elimination in the USFWS take prohibition is in place) to allow monitoring and confirmation of compliance with the funding program. The strength of the Program's reporting process is that it provides a level of accountability, documents accomplishments, and provides a foundation for planning. Its weakness is that there is no time limit for rolling over unused funds to future years. Time limits would prevent the accumulation of funds and better ensure funds are fully devoted to the timely restoration of salmonid habitat. Furthermore, inflation would erode the value of funds carried into subsequent years. The Program has no provision for adjusting these funds for inflation.

The reporting element of the Program could be used to refocus spending based on monitoring results and what is known of residual land use impacts. The Program requires that jurisdictions develop a process and schedule for ensuring spending adjustments based on monitoring.

Findings on Dependability of Funding

- The proposed Program is largely self-regulating. The primary means of determining compliance is the annual report from the participating jurisdictions to NMFS.
- The consequences of non-compliance are not well articulated.
- In addition to guidance from WRIA based planning processes, requirements for developing a process and schedule for Program adjustments (through the Habitat Acquisition and Restoration Program annual reporting process) could be used to address residual land use impacts.

6.7.4 Conclusions

1. The funding level proposed in the program is adequate to fund a significant amount of habitat acquisition and could result in substantial improvements to habitat and salmon populations if allocated in accord with salmonid recovery priorities.

2. By allowing the crediting of habitat spending related to category 2 projects, the program provisions governing allocation of funding in the phase one period could reduce the potential benefits to salmon recovery. Category 2 projects that are prioritized by fish-friendly ranking principles (as in the Stormwater Program) and category 1 projects (guided by near-term WRIA based planning processes) would likely provide greater habitat benefits for salmonids.

3. Following completion of the WRIA conservation plans (during phase 2), funding would be expected to be used for scientifically planned projects.

4. The dependability of the funding commitments under the proposed program relies heavily on the annual reporting requirement and the consequences of non-compliance are unclear.

5. Unspent Tri-County funds carried forward into succeeding years would have to be adjusted for inflation to avoid deterioration of buying power.

6.8 CONCLUSIONS OF INDIVIDUAL EFFECTS OF THE INDIVIDUAL MODEL PROGRAMS

The flow control facilities proposed in the stormwater program would control peak flows and the duration of erosive flows from new EIAs in any sub-basin. Where significant clearing or development has already occurred (>50% of landscape in the Tri-County area), development and redevelopment activities would reduce peak flows and durations because the flow duration standard is to match historic (i.e., forested) flow peaks and durations. The Model does not directly address sub-basin-scale protection of base flows, which would rely on jurisdictions to implement regional facilities or other actions. The Stormwater Management Program would contribute to maintaining water temperature, sediment and turbidity conditions, although water temperatures could be degraded in cases where ground water discharge is substantially affected. It would also generally maintain, but could degrade, chemical and nutrient water quality conditions. The Stormwater Management Program would contribute toward maintaining habitat access, pool quality, off-channel habitat, refugia, and floodplain connectivity. It would not, however, address the large woody debris condition. This program would contribute to maintaining road density, drainage network, and forest cover conditions in rural areas, and it would contribute to maintaining riparian reserves.

The Stormwater Management Program partially meets the requirements of the MRCI limit formulated by NMFS and substantially addresses potential impacts associated with new development and construction of new stormwater discharges. It relies on other programs (primarily Land Management) to maintain or improve PFC and meet the MRCI limit. Existing habitat conditions, except for base flows, would generally be expected to be maintained through the Stormwater Management Program in the short term. In the long term, flow controls and stormwater CIPs would be expected to improve peak flows and durations; in turn, this would improve channel conditions. The Stormwater Management Program would allow continued development to degrade base flows.0

The Land Management Program would generally protect existing mature riparian forest and immature riparian forest, allowing the immature forest to mature over time. This protection would be provided through MZ regulations and CMZ designations designed to protect or improve natural stream process. The Land Management Program would not protect existing conditions from degrading in the OMZ where the OMZ is in a forested condition. Potentially, the entire OMZ could be cleared as long as the 65% retention standard for the entire MZ of a site is met.

An important objective of the Land Management Program is to not preclude future restoration opportunities. Areas within the MZ that are cleared, but not developed, would generally be protected against new development and retained in a condition that would allow incremental natural reforestation or preserve the MZ area for restoration activities.

Improvement of riparian conditions in the long-term (either by maturation of existing vegetation or habitat restoration) would maintain or contribute to improvement of many habitat indicators that are affected or driven by riparian vegetation. Habitat indicators that could potentially be improved through improved riparian buffers include peak/base flows, water temperatures, streambank stability, chemical and nutrient water quality, large woody debris recruitment, off-channel habitat, refugia, floodplain connectivity, and riparian reserves. Maintenance and long-term maturation of MZs would have different effects on habitat indicators in wider streams or rivers (e.g., Puyallup, Snohomish, and Middle Green River where shading by riparian vegetation has relatively little effect on water temperatures).

Large woody debris is of particular importance to channel and habitat formation processes. The Land Management Program would maintain or improve the potential for large woody debris recruitment through riparian protection. In previously developed areas, large woody debris may be improved over time as redevelopment that includes provisions of the Land Management Program occurs.

In heavily urbanized areas with little existing functional riparian habitat, MZ regulations would have little effect on stream habitat functions. Special or key habitat areas retaining substantial biological functions should receive greater protection. Improvement of degraded conditions in urbanized areas would ultimately rely on jurisdictions to implement riparian restoration projects in key areas identified through the Monitoring and Adaptive Management, WRIA Based Planning, and Habitat Acquisition and Restoration Funding Programs.

WRIA Based Planning and Monitoring and Adaptive Management Programs have the potential to guide effective actions that would contribute to maintenance or improvement of PFC. In particular, these programs are necessary to identify additional regulatory, programmatic, or capital actions that would be necessary in addition to the early-action programs in both the near term and long term. The role of adaptive management is clearly included in the Model; however, the processes for achieving monitoring and adaptive management are not clearly defined.

The Habitat Acquisition and Restoration Funding Program is a key component of the Model for habitat restoration. It has the potential to substantially contribute to the salmonid habitat conservation and restoration in the region. Through the WRIA Based Planning Program, appropriate projects can be selected and funded to improve valuable habitat components. The 1% funding level would provide cumulative benefits over time if allocated in accord with salmonid recovery priorities. Particularly following completion of the WRIA conservation plans, funding would be expected to be used for scientifically planned projects. The dependability of the funding commitments under the proposed program relies heavily on the annual reporting requirement and the consequences of non-compliance are unclear. Buying power under the Model could deteriorate over time if unspent Tri-County funds are carried forward into succeeding years without adjusting for inflation.

7. SYNERGISTIC EFFECTS OF THE MODEL PROGRAMS

Chapter 7 evaluates the synergistic or combined effects of implementing multiple Tri-County Model 4(d) Rule Response Proposal (Model) Programs. Herein, we identify the synergy among programs that would contribute to maintaining existing or improvement toward properly functioning (habitat) conditions (PFC) for chinook and bull trout, and that would fulfill the considerations of the National Marine Fisheries Service (NMFS) Final 4(d) Rule for Municipal, Residential, Commercial, and Industrial (MRCI) Development and Redevelopment Activities. Synergy, as defined in Chapter 3 for this analysis, is the combined effects of the Model programs, whether those effects are additive or greater than the sum of individual effects. Although the individual effects of the Regional Road Maintenance ESA Program Guidelines are reviewed in a separate biological review, they are included in this evaluation of synergistic effects.

Chapter 7 includes the following sections:

7.1 Basis for Synergistic Effects Analysis

7.2 Synergistic Effects on PFC for Chinook Salmon and Bull Trout

- 7.2.1 Peak Flows and Erosive Flow Durations
- 7.2.2 Base Flows
- 7.2.3 Temperature
- 7.2.4 Sediment, Turbidity, and Substrate
- 7.2.5 Chemicals and Nutrients
- 7.2.6 Physical Barriers
- 7.2.7 Large Woody Debris
- 7.2.8 Pool Frequency, Pool Quality, Width-to-Depth Ratio, Streambank Condition
- 7.2.9 Off-Channel Habitat, Refugia, and Floodplain Connectivity
- 7.2.10 Drainage Network and Road Density
- 7.2.11 Disturbance History (Forest Cover)
- 7.2.12 Riparian Reserves

7.3 Consistency with MRCI Limits

7.4 Conclusions

7.1 BASIS FOR SYNERGISTIC EFFECTS ANALYSIS

We evaluated the potential effects of implementing individual Model Programs in Chapter 6 and concluded that implementation of either the Land Management or Stormwater Management Programs individually would not be expected to improve habitat conditions toward PFC or even maintain existing conditions in many areas, nor would they be completely consistent with the MRCI limit. Chapter 7 identifies where synergy between the Land Management and Stormwater Management Programs would contribute to maintaining existing conditions or improvement toward PFC and, in turn, meet many of the MRCI limit provisions. We also note herein where a watershed-scale outcome, would rely on participating jurisdictions to implement long-term action programs (Watershed Based Salmonid Conservation Planning [WRIA Based Planning], Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs). Tri-County jurisdictions would provide detailed plans to the certifying agencies with measurable milestones for implementation of these long-term action programs when jurisdictions apply for 4(d) limits (see Chapter 8 of the Model).

This chapter evaluates the additional effects of the Regional Road Maintenance ESA Program (Regional Road Maintenance ESA Forum 2002a) on PFC and identifies where this program affects the Model's conformance with the MRCI considerations. The biological review of the Regional Road Maintenance ESA Program describes outcomes of best management practices (BMPs) and the effect of road maintenance activities on PFC indicators with and without the Regional Road Maintenance ESA Program. However, it does not describe the pathway between the BMP outcomes and the effects on PFC indicators, or the expected significance of improvement or degradation effects. The significance of this program in affecting PFC and MRCI limit considerations in this analysis is premised on the program primarily affecting PFC indicators through two pathways. On a basin scale, it will control sediment and chemical pollution from road maintenance activities. At stream crossings, it will reduce or eliminate barriers by maintaining adequate crossings and removing blocking debris. It can also contribute to improvement of appropriate channel condition, native vegetation, and large woody debris.

Because the evaluation of synergistic effects on PFC applies to trends in PFC indicators of habitat condition, it addresses both chinook salmon and bull trout (see discussion in Chapter 3).

The Regional Road Maintenance ESA Program Guidelines are evaluated in a separate biological review. Applied individually, the Regional Road Maintenance ESA Program would not address the MRCI limit provisions. However, road maintenance activities can obtain 4(d) coverage as a stand-alone program under MRCI limit 10. For Limit 10 coverage, the Regional Road Maintenance ESA Program would not require implementation of any of the other early-action or long-term programs, but it does include its own monitoring and adaptive management element. The Regional Road Maintenance ESA Program would contribute to the effects of the Model on PFC.

7.2 SYNERGISTIC EFFECTS ON PFC FOR CHINOOK SALMON AND BULL TROUT

Primary and secondary effects of the programs are defined in Section 3.1. Where more than one program would have a primary effect, we generally conclude that synergy occurs among programs occurs and that this interaction would contribute to the maintenance or improvement of habitat conditions toward the PFC indicator. Restoration of habitat to PFC is not a Model goal. However, one of the Model's goals is to restore and maintain salmonid populations and their habitat. This BR evaluates if the Model accomplishes habitat conservation for listed species consistent with the ESA and the NMFS 4(d) Rule (which calls for conserving listed salmonids by maintaining and restoring PFC). Therefore, the synergy between programs is evaluated by how they maintain existing conditions or improve toward PFC. Synergistic program effects on PFC are summarized in Table 7-1.

Table 7-1 also summarizes the overall effect of the Model on properly functioning (PF), at risk (AR), and not properly functioning (NPF) habitat in rural and urban areas. These determinations are based on the sub-basin analyses described in Chapter 5, Appendix L, and the subsections below. Generally, where a range of effects (e.g., maintain – improve) is indicated, the lesser effect is based on the early-action programs, while the greater effect is assumed to be based on aggressive implementation of the long-term programs in combination with the early-action programs.

Table 7-1. Summary of Synergistic Program Effects on PFC

PFC Element	Degree of Effect on PFC Indicator			Effect on Rural Habitat[c, d]			Effect on Urban Habitat[c, d]		Synergy Among Programs Necessary to Maintain/ Improve PFC[e]
	Stormwater Management	Land Management	Regional Road Maintenance	PF	AR	NPF	AR	NPF	
Peak Flows and Durations	primary	secondary	secondary	maintain	maintain – improve	improve	maintain – improve	improve	no
Base Flows	primary	secondary	secondary	degrade	degrade	maintain	degrade	maintain	no
Temperature	primary	primary	secondary	degrade	degrade – maintain	maintain	degrade – maintain	maintain	yes
Sediment, Turbidity, Substrate	primary	primary	primary	degrade – maintain	maintain – improve	maintain – improve	maintain – improve	maintain – improve	yes
Chemicals/Nutrients	primary	primary	primary	degrade – maintain	maintain – improve	maintain – improve	maintain – improve	maintain – improve	yes
Physical Barriers	primary	primary	primary	maintain	improve	improve	improve	improve	yes
Large Woody Debris	insignificant	primary	secondary	maintain	maintain – improve	maintain – improve	maintain – improve[a]	maintain – improve[a]	no
Pool Frequency, Pool Quality, Width/Depth Ratio, Streambank Condition	primary	primary	primary	maintain	maintain – improve	maintain – improve	maintain – improve[a]	maintain – improve[a]	yes
Off-Channel Habitat, Refugia, Floodplain Connectivity	primary	primary	secondary	maintain	maintain – improve	maintain – improve	maintain – improve[a]	maintain – improve[a]	yes
Drainage Network, Road Density/ Location[b]	secondary	secondary	insignificant	degrade	degrade	degrade	degrade	degrade	--[f]
Disturbance History	primary	primary	insignificant	degrade	maintain – degrade	maintain	maintain – degrade	maintain	yes
Riparian Reserves	secondary	primary	insignificant	degrade – maintain	maintain – improve	maintain – improve	maintain – improve[a]	maintain – improve[a]	no

[a] Properly functioning conditions for these indicators cannot be achieved because the urban MZ standard limits the degree to which these indicators can be improved. However, these important habitat indicators can be improved relative to existing conditions (see table footnote d above).

[b] Criteria for drainage network and road density are not appropriately defined for Puget Sound lowland streams; however, these determinations assume that continued road development will degrade these indicators.

[c] See definitions of improve, maintain, and degrade used in this biological review, in Section 3.1.

[d] In most cases, improvement of indicators will depend on (1) habitat restoration implemented through the long-term programs, and (2) maturation of riparian vegetation in the long term.

[e] If more than one program has a primary effect, then synergy is assumed to be necessary to maintain or improve indicators.

[f] No programs have a primary effect on these indicators; additional regulatory and programmatic measures will be necessary to maintain or improve indicators.

7.2.1 Peak Flows and Erosive Flow Durations

The Stormwater Management Program would have the primary effect on maintaining and improving peak flows and durations. As discussed in Section 6.2.1, the technical flow control standards would maintain and improve peak flows and durations on a site scale. In particular, improvement would occur because many sites are already cleared, and flow controls are required to match flow peaks and durations to site conditions that existed prior to any development in the Puget Sound region. Sub-basin-scale maintenance or improvement of flows would be expected to rely on jurisdictions to implement the Stormwater Management, WRIA Based Planning, and Monitoring and Adaptive Management Programs to identify where additional regulatory, programmatic, or capital actions (e.g., regional facilities) would be necessary to maintain or improve flows. Capital facilities would need to be funded through the stormwater management Capital Improvement Program (CIP) funding element or the Habitat Acquisition and Restoration Funding Program.

Secondary effects would be expected to occur from the Land Management and Regional Road Maintenance Programs. Although the Land Management Program would be expected to maintain or incrementally improve infiltration and dispersion in management zones (MZs) (thus reducing surface runoff impacts to peak and base flow), its effects would be minor due to the small amount of land contained in the MZ relative to entire sub-basins. Implementation of the Regional Road Maintenance ESA Program Guidelines would also be expected to maintain or incrementally improve flow conditions where degradation might have occurred without the program or past degradation occurred. Because of the relatively small area affected the Road Maintenance Program effects would not be critical to maintaining flows.

The Stormwater Management Program individually would be necessary to maintain peak flows and durations in the short term and improve peak flows and durations in the long term. The Land Management and Regional Road Maintenance Programs would have beneficial secondary effects.

7.2.2 Base Flows

The Model would be expected to allow degradation of base flows. However, the Model programs would reduce development impacts to infiltration and groundwater recharge, as described below.

The Stormwater Management Program would have the primary effect of reducing degradation of base flows. Technical standards imposed by this program would reduce losses caused by new impervious area and redevelopment of existing impervious area. The Rural 65/10 Residential Site Standard (in rural areas), full dispersion of runoff from impervious surfaces, infiltration and dispersion BMPs, and infiltration facilities would be expected to reduce loss of groundwater recharge and resulting base flow impacts, but would not prevent degradation of base flows. Minimizing impacts to base flows would require jurisdictions to implement the Stormwater Management, WRIA Based Planning, and Monitoring and Adaptive Management Programs to identify where additional regulatory, programmatic, or capital actions (e.g., regional facilities) would be necessary. Capital facilities would need to be funded through the stormwater CIP funding element or the Habitat Acquisition and Restoration Funding Program.

Secondary effects would be expected to occur from the Land Management and Regional Road Maintenance Programs through incremental effects similar to those discussed in Section 7.2.1 for peak flows and durations. These programs, however, would not be critical to reducing base flow impacts, in part because the area of land affected by the Land Management and Road Maintenance Programs is small relative to entire sub-basin areas.

The Stormwater Management Program would be necessary primarily to reduce impacts to base flows. The Land Management and Regional Road Maintenance Programs would have beneficial secondary effects.

7.2.3 Temperature

The Model programs would contribute to maintaining or allow degradation of temperature conditions. The Land Management and Stormwater Management programs would reduce degradation of temperature by reducing base flow impacts (Section 7.2.2) and improving shading/microclimate, respectively. The Stormwater Management Program would affect maintenance of groundwater recharge and base flows through infiltration and dispersion (see Sections 6.1.1 and 6.1.2), while the MZ regulations would be expected to protect riparian forest (see Section 6.4.1). Both programs would rely on jurisdictions to implement WRIA Based Planning and Monitoring and Adaptive Management Programs to identify where additional regulatory, programmatic, or capital actions would be necessary to reduce impacts to base flows and riparian buffers, and to fund actions through the Habitat Acquisition and Restoration Funding Program. The outcome of these programs would depend on the combined effects of the programs. For example, where the Stormwater Management Program can maintain or provide only minor base flow degradation and the Land Management Program can improve shading, the synergistic effects would maintain temperature conditions.

Synergy between the Stormwater Management and Land Management Programs would occur and would be necessary to maintain temperature. The Regional Road Maintenance ESA Program would have beneficial secondary effects.

7.2.4 Sediment, Turbidity, and Substrate

The Land Management, Stormwater Management, and Regional Road Maintenance Programs would all have primary effects on maintaining or improving sediment, turbidity, and substrate conditions. This analysis assumes that the programs will be implemented and monitored in a manner that will avoid substantial violations of Model regulations. Water quality treatment facility maintenance and temporary erosion and sedimentation controls (TESC) elements associated with the Stormwater Management Program would maintain or reduce sediment levels (see Section 6.3.4). The combined effects of the Stormwater Management Program, Rural 65/10 Residential Site Standard (in rural sub-basins; see Appendix B), infiltration/dispersion, and flow duration control elements would be expected to maintain or decrease the duration of erosive flows. Over the long-term, the Land Management Program would maintain or improve streambank stability (see Section 6.3.8), thus reducing erosion and sedimentation. The early-action programs would rely on jurisdictions to implement the Stormwater Program planning element, WRIA Based Planning, and Monitoring and Adaptive Management Programs to identify where additional regulatory, programmatic, or capital actions would be necessary to maintain or improve flows and streambank stability. Implementation of the Regional Road Maintenance ESA Program would maintain sediment, turbidity, and substrate at existing conditions in instances where degradation might have occurred without this program.

Synergy among the Stormwater Management, Land Management, and Regional Road Maintenance Programs would occur and would be necessary to maintain or improve sediment, turbidity, and substrate.

7.2.5 Chemicals and Nutrients

The Land Management, Stormwater Management, and Regional Road Maintenance Programs would all have primary effects on maintaining or allowing degradation of chemical and nutrient water quality conditions. Treatment, source control, Rural 65/10 Residential Site Standard, illicit discharge reduction, and TESC elements associated with the Stormwater Management Program would be expected to control

most chemical and nutrient pollution. While the Stormwater Program provisions do not include regulatory controls for chemical use on lawns the state and other entities have initiated a process that will likely result in such controls (see Section 6.1.5). The Land Management Program would be expected to maintain or improve biofiltration through riparian vegetation (see Section 6.3.5). Implementation of the Regional Road Maintenance ESA Program would be also expected to maintain chemical and nutrient water quality in instances where degradation might have occurred without the program.

Synergy among the Stormwater Management, Land Management, and Regional Road Maintenance Programs is likely to occur and would be necessary to maintain chemical and nutrient water quality. Without the synergistic effects of these programs, some degradation would occur.

7.2.6 Physical Barriers

The Land Management, Stormwater Management, and Regional Road Maintenance Programs would all have primary effects on maintaining or improving existing habitat access by requiring the following measures: inspecting and improving culverts, removing temporary and permanent blockages at road crossings, and preventing construction of instream structures. In addition, the Model would rely on jurisdictions to implement the Stormwater Program planning element, WRIA Based Planning and Monitoring and Adaptive Management Programs to identify where additional regulatory, programmatic, or capital actions would be necessary to maintain or improve habitat access. The Model would also rely on other existing regulations and programs outside the Model to prohibit construction of new barrier-forming culverts.

Synergy among the Stormwater Management, Land Management, and Regional Road Maintenance Programs would occur and would be necessary to maintain or improve habitat access.

7.2.7 Large Woody Debris

The Land Management Program would have the primary effect on maintaining or improving large woody debris conditions (see Section 6.3.7). Most improvement would only occur in the long-term. Maintenance or improvement of large woody debris along stream reaches with existing highly cleared buffers would rely on jurisdictions to implement WRIA Based Planning and Habitat Acquisition and Restoration Funding Programs to identify areas in need of improvement, improve buffers, and/or to add large woody debris directly to the channel.

At a minimum, the Land Management Program individually would be necessary to maintain or improve large woody debris conditions. Implementation of the Regional Road Maintenance ESA Program would also be expected to maintain or improve (via improvement associated with maintenance activities) large woody debris in instances where degradation might have otherwise occurred without this program, but its effects would be secondary. The Stormwater Management Program is not expected to have a significant effect on large woody debris. Movement of large woody debris within the streams would be improved by control of peak storm flows through the Stormwater Management Program. This program requires flow controls to match flow peaks and durations to site conditions that existed prior to any development in the Puget Sound region.

In the urban areas large woody debris would not be improved by the urban MZ standard of a 115-ft inner management zone (IMZ) and an 85-ft outer management zone (OMZ; with no vegetation retention standards beyond the MZ). Other conditions such as natural channel forming processes that rely on large woody debris would be improved by the urban MZ criteria.

7.2.8 Pool Frequency, Pool Quality, Width-to-Depth Ratio, Streambank Condition

The Land Management, Stormwater Management, and Regional Road Maintenance Programs would all have primary effects on maintaining or improving pool frequency, pool quality, width-to-depth ratio, and streambank conditions. The Stormwater Management Program would be expected to maintain or reduce the duration of erosive flows, as discussed in Section 7.2.1. Section 7.2.4 discusses how all three early-action programs would maintain or improve sediment conditions, which would maintain or improve pool quality. Similarly, maintenance or improvement of large woody debris conditions resulting from the Land Management Program (see Section 7.2.7) would also contribute toward maintaining these conditions, since large woody debris is a key element in formation and maintenance of pool and channel conditions. The early-action programs would rely on jurisdictions to implement the Stormwater Program planning element, WRIA Based Planning, and Monitoring and Adaptive Management Programs to identify where additional regulatory, programmatic, or capital actions would be necessary to maintain or improve flows and riparian buffers, and to fund them through the Habitat Acquisition and Restoration Funding Program.

Synergy among the Stormwater Management, Land Management, and Regional Road Maintenance Programs would occur and would be necessary to maintain or improve pool frequency, pool quality, width-to-depth ratio, and streambank condition.

7.2.9 Off-Channel Habitat, Refugia, and Floodplain Connectivity

Both the Land Management and Stormwater Management Programs would have primary effects on maintaining or improving off-channel habitat, refugia, and floodplain connectivity. Under Washington State Growth Management Act (GMA), jurisdictions are required to use best available science to designate and protect critical areas. The land use element in the Stormwater Management Program implements this requirement through the comprehensive plan policies included in the Model. This element would rely on jurisdictions to demonstrate how they will require identification and protection of these areas through the permitting process. The Land Management Program would maintain off-channel habitat, refugia, and floodplain connectivity by protecting the channel migration zones (CMZs) with intact riparian buffers and preventing construction of additional dikes, levees or other channel stabilization techniques other than revegetation (see Section 6.3.9). Both programs would rely on jurisdictions to implement WRIA Based Planning and Monitoring and Adaptive Management Programs. These programs would identify where additional regulatory, programmatic, or capital actions would be appropriate to improve off-channel areas and refugia (e.g., removal or setback of dikes) and to fund them through the Habitat Acquisition and Restoration Funding Program.

Implementation of the Regional Road Maintenance ESA Program would also be expected to maintain or incrementally improve off-channel habitat, refugia, and floodplain connectivity where degradation might have occurred without the Program, but its effects would be secondary. Improvement of off-channel habitat may occur through road maintenance where habitat has previously been isolated from the streams.

Synergy between the Stormwater Management and Land Management Programs would be necessary to maintain or improve off-channel habitat, refugia, and floodplain connectivity. The Regional Road Maintenance ESA Program would have beneficial secondary effects.

7.2.10 Drainage Network and Road Density

None of the programs is expected to primarily address road density and drainage network conditions.

The Stormwater Management and Land Management Programs would have secondary effects by reducing road density and drainage network density. The land use element of the Stormwater

Management Program would require jurisdictions to use best available science to review and approve new road construction. To ensure effectiveness, jurisdictions would be required to establish specific review and approval protocols. The Land Management Program would be expected to reduce the rate of increase, but is not likely to reduce road density by its limitations on road crossings, or its requirement that a habitat evaluation be prepared for larger projects. The habitat evaluation requires analysis of alternatives and selection of the alternative having the least impact on the environment.

The Regional Road Maintenance ESA Program is not expected to have a significant effect on drainage network and road density. Synergy from the Stormwater Management and Land Management Programs would tend to maintain drainage network and road location and density conditions (e.g., removal or setback of dikes, preventing development, etc.). These programs will minimize the demand for roads in the immediate vicinity of streams, and minimize their adverse effects where roads are constructed.

7.2.11 Disturbance History (Forest Cover)

The Land Management Program, with support from the Stormwater Management Program, would maintain forest cover. The Rural 65/10 Residential Site Standard of the Stormwater Management Program would contribute to maintaining forest cover. In rural sub-basins with more than 65% forest cover (these sub-basins comprise 17% of the non-urban growth area (UGA) land area[43]), the Rural 65/10 Residential Site Standard would allow a decrease in forest cover. In sub-basins with less than 65% forest cover, the Rural 65/10 Residential Site Standard would generally maintain the forest cover. The Rural 65/10 Residential Site Standard does not apply in the UGA (see Section 6.1.11 and Appendix B). The fixed regulation MZs in the Land Management Program would not increase the area of riparian reserves, but the quality of existing riparian vegetation and soils would be expected to increase in the long term (see Section 6.3.11). Certainty of progress toward meeting sub-basin-scale forest cover goals (whether in urban or rural designated areas) would rely on jurisdictions identifying, acquiring, protecting, and improving forested areas by implementing the WRIA Based Planning and Habitat Acquisition and Restoration Funding Programs. Sub-basin forest cover condition is also dependent on the management of state and federal forest lands and state and federal management of forest practices. Synergy between the Stormwater Management and Land Management Programs would occur and would be necessary to maintain natural disturbance regimes. The Regional Road Maintenance Program would not be expected to have a significant effect on disturbance history.

7.2.12 Riparian Reserves

The Land Management Program would maintain riparian reserves at current levels in the short term and improve riparian reserves in the long term outside of UGAs, primarily due to reforestation of currently unforested and undeveloped MZs (see Section 6.3.12). Improvement of riparian habitat in highly developed areas would depend on whether, and to what extent, jurisdictions applied the WRIA Based Planning and Monitoring and Adaptive Management Programs to this issue. These programs could identify where additional regulatory, programmatic, acquisition, and restoration actions would be appropriate to maintain or improve MZs, and how to fund improvements through the Habitat Acquisition and Restoration Funding Program.

The clearing/grading review, development inspection, and code enforcement elements of the Stormwater Management Program provide critical secondary effects to ensure riparian areas are protected from direct (e.g., clearing) and indirect disturbances (e.g., sedimentation).

[43] Non-UGA area comprises 83% of the total Tri-County region.

In the UGAs of the Tri-County area, the Riparian Reserve element would not be sufficient to improve all biological functions and natural habitat-forming processes that largely rely on riparian buffers. The urban MZ criteria would improve conditions such as natural channel formation processes to some extent.. However, special habitat areas requiring greater protection would not be fully protected by the urban criteria. Additional criteria needed for designation and protection of these high-priority areas would include current or potential chinook salmon and bull trout use, land use, and riparian existing condition characteristics. Refer to Section 4.3.1.2 for further discussion.

The Land Management Program individually would maintain riparian reserves, and the Stormwater Management Program would have beneficial secondary effects as described above. The Regional Road Maintenance ESA Program would not be expected to have a significant effect on this PFC indicator.

7.3 CONSISTENCY WITH MRCI LIMIT

The overall consistency of the Model with the MRCI limit is summarized in Table 7-2. (see Appendix E for a discussion of the MRCI limit).

The conformance values of the Stormwater Management and Land Management Programs for each MRCI consideration (based on information in) are shown in Table 7-2, which also notes the degree to which the Regional Road Maintenance ESA Program contributes to this conformance. Finally, the Overall Model column of Table 7-2 rates the expected synergistic effects of each of these programs. The assessment of synergistic effects is based on whether a single program or the combined effects of two or more programs would substantially or partially meet the MRCI consideration. The rationale for this determination is presented in the Discussion column in the table. The discussion considers how other regulations or programs may apply where the Model does not substantially address the MRCI consideration,

The WRIA Based Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs are not included in Table 7-2 because we assumed that these three long-term action programs would be implemented along with the Stormwater Management, Land Management, and Regional Road Maintenance Programs. The Discussion column in Table 7-2 notes specifically where conformance with the MRCI limit relies on a jurisdiction to demonstrate how it will implement the long-term action programs.

Table 7-2. Analysis of Tri-County Model and MRCI Limit Evaluation Considerations

	Addresses MRCI Considerations[a]				
MRCI Limit Consideration	**Stormwater Management**	**Land Management**	**Additionally Addressed by Regional Road Maintenance (Limit 10)**	**Overall Model[b]**	**Discussion**
1. Sensitive Areas	partially	partially	partially	partially	Although the Model does not substantially address this consideration outside of the management zones, other provisions of state and federal law provide for protection of sensitive areas.
2. Water Quantity/ Quality	partially	partially	partially	partially	The technical requirements of the Stormwater Management, Land Management, and Regional Road Maintenance Programs would generally be

Table 7-2. Analysis of Tri-County Model and MRCI Limit Evaluation Considerations (Continued)

MRCI Limit Consideration	Addresses MRCI Considerations[a]				Discussion
	Stormwater Management	Land Management	Additionally Addressed by Regional Road Maintenance (Limit 10)	Overall Model[b]	
					expected to maintain water quality and quantity on a site scale, as discussed in Chapter 6, except for base flows, which would be degraded. Certainty of watershed scale protection of water quality and quantity would depend on jurisdictions demonstrating how they will use Stormwater Planning and Capital Improvements, Source Control and Public Education Programs, Watershed Planning, Adaptive Management, and Habitat Funding to identify, fund, and implement additional regulatory, programmatic, or capital actions.
3. Riparian Zones	partially	partially	partially	partially	As discussed in Section 6.3.12, the Land Management Program is expected to maintain riparian reserves at current levels in the short term, and maintain or improve riparian reserves in the long term, primarily due to the MZs. However, the regulations do not ensure protection of riparian vegetation out to 1-SPTH (site potential tree height) from the IMZ[c].
4. Stream Crossings	not intended	substantially	substantially	substantially	The Land Management Program allows for a stream crossing only if there is no other practicable alternative with less impact on riparian habitat or to the listed species. The crossing must allow for uninterrupted movement of wood and gravel and must be designed according to WDFW and NMFS guidelines. Regional Road Maintenance BMPs are integral to maintaining stream crossings.
5. Streambank Condition/CMZ	partially	partially	partially	substantially	Although each program only partially addresses this MRCI consideration, the synergy between the Stormwater Management and Land Management Programs brings the Model to substantially protect streambank stability and the CMZ. As discussed in Sections 7.2.4, 7.2.8, and 7.2.9, the Stormwater Management Program addresses erosive flows, while the Land Management Program protects existing streambank vegetation and connected CMZs. Certainty of watershed-scale protection or improvement of streambank conditions and CMZs would depend on jurisdictions demonstrating how they will use stormwater planning and capital improvements, watershed planning, adaptive management, and habitat funding identify, fund, and implement additional regulatory, programmatic, or capital actions.
6. Wetlands	partially	partially	partially	partially	Although the Model does not substantially

Table 7-2. Analysis of Tri-County Model and MRCI Limit Evaluation Considerations (Continued)

MRCI Limit Consideration	Addresses MRCI Considerations[a]				Discussion
	Stormwater Management	Land Management	Additionally Addressed by Regional Road Maintenance (Limit 10)	Overall Model[b]	
					address this consideration, other provisions of state and federal law provide for protection of wetlands.
7. Peak Flow Conveyance	not intended[d]	substantially	substantially	substantially	No new or expansion of permanent streambank stabilization, erosion hazard protection, or flood protection structures that might increase water velocities, flood potential, and channel erosion are authorized under the Land Management Program. The maintenance element of the Regional Road Maintenance ESA Program would preserve stream channel peak flow conveyance.
8. Native Landscaping	partially	partially	partially	partially	The Stormwater Management Program would be expected to contribute toward maintaining forest cover in rural areas. The Stormwater Management Program does not address forest cover in urban-designated areas, except through efforts to encourage low impact development BMPs through the land use element. The Land Management Program would be expected to contribute to maintaining forest cover within management zones, but not throughout a basin. Outside of MZs and rural areas protected by the Rural 65/10 Residential Site Standard, the Model does not appreciably require native landscaping.
9. Erosion/ Sedimentation	substantially	partially	substantially	substantially	The technical requirements of the Stormwater Management, Land Management, and Regional Road Maintenance Programs would generally be expected to control erosion and sedimentation.
10. Water Supply	not intended	not intended	not intended	not intended	The Model does not address water supply. Counties and cities in the Tri-County region have varying degrees of authority and responsibility for water supply.
11. Monitor/ Enforce/Fund	Monitoring: partially Enforcement: substantially Funding: substantially	Monitoring: partially Enforcement: partially Funding: partially	N/A	Monitoring: partially Enforcement: substantially Funding: substantially	The Model does not fully address the monitoring portion of this consideration. The Monitoring and Adaptive Management Program does not provide specific regional protocols or identify the process by which regional protocols will be established.[e] Thus, consistent and useful monitoring programs across jurisdictional boundaries can not be assured. Development inspection and enforcement, clearing/grading review, stormwater facility inspection, and stormwater planning review elements required by the Stormwater Management Program would partially address this consideration, but would rely on

Table 7-2. Analysis of Tri-County Model and MRCI Limit Evaluation Considerations (Continued)

MRCI Limit Consideration	Addresses MRCI Considerations[a]				Discussion
	Stormwater Management	Land Management	Additionally Addressed by Regional Road Maintenance (Limit 10)	Overall Model[b]	
					jurisdictions to provide implementation details when applying for MRCI limit coverage. The Habitat Acquisition and Restoration Funding Program establishes a funding process, but would rely on additional safeguards to ensure projects and programs (i.e., HCP, etc.) with mixed salmonid and non-salmonid benefits are not over-credited toward achieving the 1% commitment by a jurisdiction. Although the Regional Road Maintenance ESA Program includes compliance monitoring, scientific research, and biological data collection, these elements do not improve the Model's conformance for MRCI development activities beyond roads.
12. State and Federal Laws	partially	partially	partially	partially	Based on the introductory text for each program, the Model appears to be consistent with, and appropriately incorporates or relies on, most state and federal laws, including the GMA, CWA/NPDES, and Puget Sound Water Quality Management Plan. No apparent conflicts with other laws were noted, except that the Rural 65/10 Residential Site Standard and Land Management Program do not account for the fact that most non-conversion forest activities may be undertaken without local permitting (RCW 76.09.050).

[a] The Regional Road Maintenance ESA Program is evaluated in a separate biological review. Implementation of the Watershed - Based Salmon Conservation Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs is assumed to be intrinsic to the Stormwater Management and Land Management Programs.

[b] **Substantially** = the Model or program appreciably addresses the consideration. **Partially** = the Model addresses a portion of the MRCI consideration but its overall performance against the consideration is not conclusive. **Not intended** = program is not intended to (and does not) address this consideration.

[c.] See (a) at end of Table 6-2.

[d] MRCI consideration (G) states "MRCI development ordinance or plan adequately preserves the hydrologic capacity of permanent and intermittent streams to pass peak flows." The Stormwater Management Program does not address modifications to stream channels because activities below the ordinary high water mark are subject to state and federal law. See, e.g. RCW Ch.77.55, 33 C.F.R. Part 322.

[e] National Pollutant Discharge Elimination System (NPDES) Permits will require monitoring plans, but the NPDES Permit process does not provide for regiona/ monitoring protocols and coordination.

7.4 CONCLUSIONS

In most cases, synergy among the Model programs would occur and would be necessary to protect and maintain existing conditions in the short and long term, on a sub-basin and watershed scale. Based on the evaluation of MRCI considerations and PFC provided above, all of the early-action and long-term programs would be necessary to ensure that the MRCI considerations and PFC indicators are addressed by jurisdictions (although a single program may, in some instances, substantially address a single indicator or consideration). The Model would generally maintain existing conditions or potentially improve toward PFC peak flows and durations, sediment-turbidity-substrate, chemical-nutrient, physical barriers, large woody debris, pool frequency-etc., off-channel habitat, and riparian reserve indicators of PFC. Temperature, base flow and drainage network-road density, and disturbance history indicators of PFC would be either degraded or maintained at existing conditions.

The combined effects of the Model would be expected to maintain existing conditions or improve most PFC habitat indicators over the long term. However, the early action programs alone are not sufficient to improve most PFC indicators or maintain indicators in areas not previously altered by development. The long-term programs will be necessary in many situations to improve PFC indicators through habitat restoration actions. Although implementing the long-term programs is assumed to occur, the degree and specificity of their implementation is unknown. Jurisdictions would need to identify, fund, and implement specific regulatory, programmatic, and capital actions through the long-term programs to prevent degradation of some PFC indicators.

As summarized in Table 7-2, the Model substantially addresses 4 of the 12 MRCI limit considerations, partially addresses 7 considerations, and does not address 1 consideration (water supply). The Model substantially addresses stream crossings, streambank condition/CMZ, erosion/sedimentation and peak flow conveyance considerations. The Model partially addresses sensitive areas, riparian zone, wetlands, native landscaping, monitoring/enforcement/funding, and state and federal laws MRCI limit considerations. The water supply limit is not directly addressed by the Model. Because the Model does not substantially address all of the MRCI limit considerations, jurisdictions applying for this limit would need to demonstrate additional programs, as discussed below:

- Isolated Wetlands: Protection of isolated wetlands and sensitive areas would need to be addressed. These areas could be protected through existing state and federal laws (see discussion in Chapter 2).
- Native Landscaping: Jurisdictions would need to demonstrate programs or regulations to promote native landscaping.
- Monitoring Protocols: The Model does not provide monitoring protocols. Uniformity in monitoring protocols would need to be developed through processes such as National Pollutant Discharge Elimination System (NPDES) Phase II.
- Forest Practices: Permitting for non-conversion forest practices is not within the regulatory or programmatic purview of local jurisdictions. Clearing activities, regulated and permitted by the State and federal agencies could affect Model implementation. Clearing activities regulated by state and federal agencies may be improved through implementation of the state's new forest practices rules, which are based on regulatory elements of the 1999 Forest and Fish report that NMFS endorsed in Limit 13 of its 4(d) rule. Section 7 consultations on federal forest practices (and private forest practices on federal lands) in headwater areas that are evaluated using the MPI. However, qualification for the MRCI limit would not affect either factor, because forest practices are beyond the control of local jurisdictions and are not among the 12 MRCI limit criteria.

- Water Supply: Water supply is not within the regulatory or programmatic purview of most jurisdictions. According to Central Puget Sound Regional Water Suppliers' Forum (2001), the region does not currently have a structure or process for making collective regional water resource management decisions that encompasses the complex set of issues, interests, and participants related to domestic water supply and instream flows.

The synergy of the Model programs should be focused through the Monitoring and Adaptive Management Program. As new information becomes available through monitoring and other sources, it should be used to revise regulatory policies through the adaptive management process. This process is identified in the Model, but implementation of the policy is not clearly defined.

8. FINDINGS AND RECOMMENDATIONS

Chapter 8 provides a summary of the findings of this biological review, along with recommendations for jurisdictions to modify and improve the Tri-County Model 4(d) Rule Response Proposal (Model) Programs. The chapter also summarizes limitations of our evaluation and identifies recommendations for further scientific analysis that should be conducted to clarify the results of the Parametrix biological review.

Chapter 8 includes the following sections:

8.1 Consistency with Federal Guidance and Scientific Literature
- 8.1.1 Consistency with Federal Guidance
- 8.1.2 Findings on Technical Concepts
- 8.1.3 Recommendations

8.2 Model Effects on Selected Sub-Basins
- 8.2.1 Sub-Basin Findings
- 8.2.2 Application of Sub-Basin Analysis to the Tri-County Area

8.3 Individual Performance of the Stormwater Management and Land Management Programs
- 8.3.1 Individual Program Findings
- 8.3.2 Individual Program Recommendations

8.4 Synergistic Effects of All Programs and Model Consistency with 4(d) Rule Considerations
- 8.4.1 Synergistic Effects Findings
- 8.4.2 Recommendations

8.5 Conclusions

8.6 Limitations of this Biological Review

The overall purpose of this biological review is to determine whether the Model (Tri-County Salmon Conservation Coalition 2001b) accomplishes the following objectives:

- Contributes to the persistence of existing habitat functions and the restoration of additional habitat functions, sufficient to support sustainable, harvestable salmonid populations, and
- Conserves listed salmonid species consistent with the Endangered Species Act (ESA) and the National Marine Fisheries Service (NMFS) 4(d) Rule for threatened salmonids (Tri-County ESA Response Coalition 2002).

The results of this third party analysis will serve to further inform individual jurisdictions as they craft local responses to the salmonid listings. The scientific basis and rationale for the Model are described and evaluated as part of this biological review. This analysis evaluates whether (and if so, the extent to which) the Model:

- Is consistent with the ecological framework and biological principles upon which the Model relies,
- Provides additional or synergistic benefits to listed species if all program elements are implemented across a given landscape, and

- Addresses the evaluation considerations contained in the municipal, residential, commercial, and industrial (MRCI) limit in the NMFS 4(d) Rule for take protection of threatened salmonids.

As stated in Section 1.2.2, the U.S. Fish and Wildlife Services (USFWS) is considering amending their existing Special 4(d) Rule to allow some limitations of the existing Section 9 take prohibitions that are currently in place for threatened bull trout. The amendments would exempt two additional categories of other activities that may affect bull trout: (1) habitat restoration, and (2) other land and water management activities governed by enforceable regulations that provide substantial protection for bull trout. This biological review may provide a foundation for the Special 4(d) Rule amendments.

The results of this analysis are also intended to satisfy the best available science criteria for decision-making under the Washington State Growth Management Act (GMA; Ch.36.70A RCW and WAC Sections 365-195-900 through –925), and serve to further inform individual jurisdictions as they craft local responses to salmon and bull trout listings.

The Model consists of three early action and three long term action programs. The three early action programs would primarily maintain existing habitat conditions or minimize the effects that development potentially has on salmon and bull trout habitat. These programs would do little to improve previously degraded habitat, but would tend to maintain the opportunity to improve previously degraded habitat. Improvement of previously degraded habitat conditions would be accomplished primarily by the Model's long-term programs. Most of the habitat improvement is expected to be accomplished through the Habitat Funding and Acquisition Program that will be guided in part by the Monitoring and Adaptive Management Program and the Watershed Based Salmonid Conservation Planning Program (WRIA planning).Within King, Snohomish, and Pierce Counties, the area where the Model will be applied, involves primarily lowland Puget Sound streams and Puget Sound shorelines. Most of the area within the UGA already has substantial development or is in the process of developing further. Many of the sub-basins within the Tri-County area do not directly provide habitat for chinook or bull trout. About one third of the sub-basins in the Tri-County area are entirely outside the UGA (rural and resource lands), and more than 81% of the entire chinook-bearing stream miles are outside the UGA. The majority of high quality chinook spawning habitat, and all known bull trout spawning habitat, is outside the UGA (Lucchetti 2002). Within the Tri-County region, most of the essential spawning and early rearing habitat for salmon and bull trout is upstream from the areas potentially influenced by the Model. The Model will influence development in areas that are used primarily for juvenile fish rearing, migration corridors, over wintering, and foraging.

8.1 CONSISTENCY WITH FEDERAL GUIDANCE AND SCIENTIFIC LITERATURE

One purpose of the biological review was to first verify the appropriateness of the principles, habitat objectives, scientific findings, and purposes upon which the Model was based, and then evaluate the Model's consistency with the NMFS 4(d) Rule.

8.1.1 Consistency with Federal Guidance

The objectives, principles, purposes, and scientific findings of individual Model programs combine to collectively address NMFS Habitat Objective Nos. 1 (natural watershed processes), 2 (habitat for all life stages), and 4 (connectivity). The stated objectives and principles of the Model programs do not directly address NMFS Habitat Objective Nos. 3 (high quality habitat network) and 5 (genetic diversity). However, the objectives and principles of individual Model programs do not conflict with any of the NMFS Habitat Objectives. In most cases, program objectives and principles are not stated as a biological or habitat goal that can be directly compared to the NMFS Habitat Objectives.

The USFWS has published interim conservation guidance, which contains two overall objectives that are equivalent to NMFS Habitat Objective Nos. 1 (natural watershed processes) and 4 (connectivity). Implementing the Model will tend to maintain existing conditions that support the current distribution of bull trout within the Tri-County area. Generally, the Model will apply in areas that provide migratory and foraging corridors for bull trout. In these areas, water temperature is important during the spring and autumn, when bull trout migrate through the corridors. Available information indicates that bull trout prefer water temperatures not exceeding 15ºC. Existing water temperatures higher than these criteria during the mid-summer are common, but less likely to influence bull trout populations than spring and summer temperatures along migratory corridors. The Model is not likely to substantially alter water temperature conditions along potential bull trout migratory corridors.

8.1.2 Findings on Technical Concepts

The Model's principles, habitat objectives, scientific findings, and purposes are based on technical concepts and processes that are generally accepted by experts in the disciplines to represent best available science (based on available literature). The Model follows the basic principle of protecting or restoring natural habitat conditions, as they are currently understood, with the assumption that these natural conditions provide the most appropriate habitat for salmon and bull trout. The Model relies foremost on protection and encouragement of natural processes for critical portions of the habitat supporting salmon and bull trout. These include channel migration, large woody debris recruitment, sediment filtration, bank stabilization and erosion control through management of natural riparian corridors, maintenance of refugia, etc. Where natural processes cannot be used to maintain ecological functions, the Model's performance (in maintaining or improving habitat conditions) will rely on engineered facilities and habitat restoration.

Evidence available for this review indicates the framework used to develop the Model is based on best available science. The Model appears to rely on appropriate assumptions supported by the information contained in published literature. It also addresses specific policies and development regulations within the capacity of county and local jurisdictions to protect and enhance salmon and bull trout habitat. Model programs include appropriate measures to protect salmon and bull trout habitat at the existing conditions. Actual provisions within the Model may have been based in part on social and political considerations (e.g., urban buffer standard, and rural-only application of the 65/10 site standard).

The Land Management, Stormwater Management, and Regional Road Maintenance Programs will be implemented at the site scale. The regulations in these programs appear to provide substantial improvement over past practices. Regulation exemptions, exceptions, and allowances are allowed only where there are no other feasible alternatives and require mitigation to offset impacts of the exceptions. The accumulation of residual impacts through increased development at larger scales may preclude adequate protection and restoration of natural processes through site-specific regulations and individual restoration projects. The Model provides for watershed-scale habitat protection and restoration to address those impacts, but certainty of watershed-scale restoration would require jurisdictions to make as yet unspecified commitments to the Watershed Based Salmonid Conservation Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs.

8.1.3 Recommendations

Jurisdictions should specify the appropriate implementation commitments for the Watershed Based Salmonid Conservation Planning, the Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs, because the Model does not adequately do so.

The format in which these principles are stated is not consistent among programs. Jurisdictions should more clearly state the principles, habitat objectives, scientific findings, and purposes as ecological goals, and then clearly state the linkages between the program's ecological goals and its programmatic elements.

It is appropriate to recognize in the Model that habitat conditions, other than the historic natural conditions, may be satisfactory for protecting and restoring salmon and bull trout populations. Habitat conditions that support adequate biological functions in Puget Sound lowland streams and estuaries include a range of conditions different than those previously specified as PFC for headwater streams .

Measures in the Model should be improved over time as new information becomes available through the monitoring efforts and independent investigations.

8.2 MODEL EFFECTS ON SELECTED SUB-BASINS

A basic objective of the Model is to maintain existing habitat and the preserve the potential to improve habitat for the short term, and to incrementally improve appropriate habitat functions over the long term (i.e., shading, channel-forming and stabilizing elements, flow regime, etc.). This section summarizes our findings from Chapter 5 regarding the potential of the Model to accomplish this objective in six test sub-basins within Watershed Resource Inventory Area (WRIA) 9. The WRIA 9 sub-basins were selected primarily based on data availability and consistency, and then to represent a wide range of development, habitat, and salmon and bull trout life history use conditions. These sub-basins are generally representative of the range of development conditions and existing land uses of many of the sub-basins throughout the Tri-County area (Section 5.4 and Appendix C). The Soos Creek sub-basin was used as the focus of the analysis and functioned as the point of comparison for the other WRIA 9 sub-basins included in the analysis (Newaukum Creek, Middle Green River, Hamm Creek, Longfellow Creek and the Lower Duwamish River). However, none of the sub-basins analyzed is predominately rural with non-Urban Growth Area (UGA) forested habitat. We were not able to identify a sub-basin likely to be regulated by the Model with these characteristics for which appropriate information is available.

8.2.1 Sub-Basin Findings

The Soos Creek sub-basin has a drainage area of approximately 44,800 acres and contains about 60 miles of streams (King County and WSCC 2000). Major streams within the sub-basin include Big Soos, Little Soos, Soosette, Covington, and Jenkins Creeks. There are numerous smaller streams within the sub-basin as well, and three distinct stream morphologies. The headwaters are a mix of low-gradient (< 0.1%) riffles and swampy, mud-bottomed channels that flow through extensive wetland complexes. From RM 4.75 to RM 2, Soos Creek is a 1.4% gradient reach of long riffles and pools flowing through a steep-sided ravine as it descends from the plateau, where it originates, down to the Green River valley floor and floodplain. Below RM 2, the gradient decreases to 0.5%, and Soos Creek becomes a floodplain channel type.

Although much of the Soos Creek sub-basin remains rural, residential and commercial development is widespread. Areas of concentrated development include the north and west portions of the sub-basin west of Big Soos, along and east side of Little Soos near the confluence with Big Soos, and in residential communities around several lakes. Jenkins and Covington Creeks mainly contain rural residences and hobby farms, although portions of Jenkins Creek flow through developed areas. Soos Creek, below the confluence of Big Soos and Little Soos Creeks, as well as upper Little Soos Creek, is largely

undeveloped. About 48% of the sub-basin is designated UGA (Appendix C)[44], and those areas of the heaviest existing development are primarily contained within the UGA (King County and WSCC 2000). As a result of development patterns and the effects of impervious surface on infiltration rates, peak flows are higher in the more densely developed areas of the Soos Creek sub-basin, while base flows are lower.

Chinook salmon spawn primarily in the Soos Creek mainstem, below RM 6, and in lower Covington and Jenkins Creeks. There is also sporadic chinook spawning in lower Little Soos and Soosette Creeks. Bull trout are not known to occur in the Soos Creek sub-basin other than in the very lower reaches near the confluence with the Green River, where they have been documented in recent years. However, bull trout may use the watershed during the summer for foraging or seeking thermal refuge in cold water springs where they occur.

While largely rural, the Soos Creek sub-basin is rapidly developing and is expected to see increasing residential and minor commercial development within the UGA and rural residential development outside the UGA (King County and WSCC 2000). Residential use dominates the Soos Creek sub-basin, accounting for 40% of existing use and 80% of the designated use. Existing forest, primarily early to mid-successional deciduous and mix-forest types, accounts for approximately 26% of the sub-basin; scrub/shrub land covers another 10%.

Chinook, coho, pink, and chum salmon, cutthroat trout, and winter steelhead naturally spawn in the Soos Creek sub-basin. In addition, the Soos Creek State Fish Hatchery at RM 0.7 has been in operation since 1901 and currently produces substantial runs of chinook and coho salmon. A single bull trout was reportedly captured at the hatchery in 1956, but no known bull trout population currently exists in the Soos Creek sub-basin (King County and WSCC 2000); however, additional sightings of bull trout have been observed near the mouth of Soos Creek in recent years.

The general characteristics and predicted Model effects on properly functioning conditions are primarily for salmon, but are appropriate for bull trout life stages in each selected sub-basin. Findings from the analysis of other WRIA 9 sub-basins are summarized below.

Newaukum Creek was chosen because it represents rural developing land in a primarily agricultural sub-basin, and it is a significant tributary system for spawning and early rearing of salmon. Bull trout have been observed at the mouth of Newaukum Creek, but are not known to migrate or reproduce in Newaukum Creek. Because of its productivity for coho salmon and cutthroat trout, Soos Creek may have the potential to provide forage area for sub-adult and adult bull trout. Conditions in the sub-basin primarily range from not properly functioning to at risk. We expect Model implementation to at least maintain existing habitat conditions (water quality, habitat access, habitat elements, channel condition, and flow/hydrology) at existing levels, except for baseflows, which would be degraded. Existing land-use within the management zones (MZs) would largely be maintained and restoration opportunity would be preserved, particularly along the extensive reaches of Newaukum Creek that lack riparian vegetation because of agricultural practices. Restoration of riparian forest where it is currently lacking would greatly improve stream functions and could lead to restoration to PFC in the long term. Certainty of restoration to PFC depends heavily on prioritization and implementation of restoration activities, incentives, or habitat acquisition that would be defined through the Monitoring and Adaptive Management and Watershed Based Salmonid Conservation Planning Programs.

[44] For the purposes of this analysis, the Soos Creek sub-basin includes the Soos Creek, Jenkins Creek, and Covington Creek sub-basins defined in Appendix C. Therefore, the values of land use designations and existing use described in the text combine the values for these three sub-basins (e.g., 48% UGA described in text is the total percentage of UGA area for the Soos Creek, Jenkins Creek, and Covington Creek sub-basins combined).

The **Middle Green River** is a rural sub-basin with a mixture of residential and agricultural land use. Significant salmonid spawning and rearing activity, particularly for chinook, occurs in the mainstem Middle Green River. Bull trout are presumed to inhabit and forage in the mainstem Green River up to river mile (RM) 64.5. Conditions in the Middle Green River range from not properly functioning (e.g., bank conditions, off-channel habitat, physical barriers, substrate, and large woody debris) to at risk (temperature, refugia, floodplain connectivity, and base flows). Model implementation would generally be expected to at least maintain most habitat conditions at their existing state at existing levels, except for baseflows, which would be degraded in tributary streams. Upstream dams largely control flows and channel conditions, but some of the PFC indicators are not extensively constrained (in particular riparian reserves) and could be improved the long-term through forest maturation and habitat restoration/acquisition. However, properly functioning temperature conditions for bull trout and salmon spawning and rearing probably cannot be met throughout the year with any conceivable action.

Hamm Creek and **Longfellow Creek** are in built-out urban sub-basins that likely never supported significant chinook salmon populations, but do currently support other salmonids and cutthroat trout. Juvenile salmonids may concentrate for extended periods in the mainstem river, near the mouths of these streams, to feed and rear. Conditions in these sub-basins are largely not properly functioning. Because these sub-basins are extensively constrained, we expect Model implementation would generally have little effect on restoration of PFC. Historically, neither of these streams is likely to have been used by bull trout for reproduction or rearing. These streams likely provide food sources for young salmon and trout rearing at their discharge locations in the Lower Duwamish River.

The **Lower Duwamish River** is a heavily urbanized lower river estuarine system that serves primarily as a salmon and bull trout migration, rearing, and foraging corridor. Except for temperature and physical barriers, conditions in the Lower Duwamish River are generally not properly functioning for conditions including floodplain connectivity, sediment, habitat elements, channel and watershed condition indicators, flows, and water quality. However, based on apparently high survival rates, the Lower Duwamish appears to provide satisfactory conditions for salmon and bull trout migrating through and foraging in this corridor. Because the system is extensively constrained, we expect Model implementation to generally maintain these existing conditions as not properly functioning.

8.2.2 Applicability of Sub-Basin Analyses to the Tri-County Area

Most sub-basins within the Tri-County region are designated non-UGA and are currently well vegetated. Relatively few Tri-County sub-basins have equal mixes of UGA and non-UGA lands such as Soos Creek. Newaukum and the Middle Green River sub-basins lie near the median for the percentage of UGA and vegetation cover in the sub-basin and are representative of the majority of Tri-County sub-basins with respect to these categories. Longfellow Creek, Hamm Creek, and the Lower Duwamish River sub-basins are representative of highly urbanized sub-basins and represent relatively few Tri-County sub-basins. Stream reaches in the UGA do support important habitat functions for chinook salmon and bull trout (i.e., for migration, foraging, and rearing). However, spawning and early rearing habitat is more critical for chinook salmon and bull trout survival in the Puget Sound region. Most chinook-bearing stream miles, and all known bull trout spawning and early rearing habitats are within non-UGA lands and would be covered by the more restrictive rural land management regulations rather than the urban regulations.

The Model would not be expected to achieve all PFC standards for bull trout spawning and rearing with any conceivable action in these sub-basins, nor for most sub-basins within the Tri-County area where the Model will potentially be applied. Migratory and foraging conditions during spring and autumn may be maintained. Some sub-basins within higher elevations of the Tri-County area do provide PFC for bull trout. In these areas, the Model has the potential to maintain these conditions on the small amount of land

controlled by county and local jurisdictions. Other programs (i.e., Forests and Fish Report) will function to maintain PFC for bull trout on lands not regulated by the counties or local jurisdictions

Overall, highly urbanized streams would remain constrained and highly altered, but much of the little remaining riparian forest would likely be retained and would provide site- and perhaps reach-level benefits to stream habitat. In sub-basins where conditions are not extensively constrained, the Model may bring about restoration in the long term through natural processes, such as the benefits of forest maturation and channel migration (e.g., large woody debris, off-channel habitat, and erosion control), or through habitat restoration. The inner management zone (IMZ) is afforded a high degree of protection. The outer management zone (OMZ), however, is susceptible to extensive clearing on a parcel-by-parcel basis, while still meeting vegetation retention requirements if greater than 65% of the total MZ area on a parcel exists as protected vegetation (forested or otherwise not developed) within the IMZ. Exceptions to the constraints require mitigation. Regulations, including the Rural 65/10 Residential Site Standard requirements beyond the MZs, may not offset all landscape level effects resulting from increasing human population. However, the Model would largely not preclude most opportunities for future restoration within the designated inner MZs. Habitat restoration and acquisition through the Model program would be required to offset effects of future development and lead to PFC. The Model relies on the Monitoring and Adaptive Management and Watershed Based Salmonid Conservation Planning Programs to identify, prioritize, and address habitat restoration opportunities.

Implementing the Model would be expected to maintain existing habitat conditions in urban and rural sub-basins in the short term, based on this sub-basin analysis. Because conditions are generally not properly functioning or are at risk in the sub-basins analyzed, maintaining existing conditions means that conditions would be maintained in not properly functioning or at risk conditions. As demonstrated in the MZ analysis (Appendix A), the current distribution of immature and mature vegetation would be maintained within the proposed MZ boundaries. Where this occurs, habitat functions would likely improve as riparian vegetation matures over time. Riparian areas that do not currently have natural vegetation, including agricultural areas, would be maintained in a condition that would not preclude future habitat restoration opportunities, but would not improve as a result of the management zone regulations.

The Model has the potential to provide substantial improvements in habitat conditions for salmon and bull trout in the long term. These improvements depend on the extent to which restoration activities are implemented, according to best available science, through the Habitat Acquisition and Restoration Funding, Watershed Based Salmonid Conservation Planning, and Monitoring and Adaptive Management Programs.

8.3 INDIVIDUAL PERFORMANCE OF THE STORMWATER MANAGEMENT AND LAND MANAGEMENT PROGRAMS

Participating jurisdictions have the option to implement some or all of the three early-action programs (Stormwater Management, Land Management, and Regional Road Maintenance). However, in order to qualify for MRCI Limit coverage, jurisdictions would also be required to construct their 4(d) submittal on the foundation of the Watershed Based Salmonid Conservation Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs. The Stormwater Management and Land Management Programs are the major stand-alone regulatory programs that directly affect habitat conditions and the potential for future habitat restoration; they are each reviewed separately in this analysis. The Regional Road Maintenance Program has been independently reviewed as a stand-alone program in a separate biological review (Regional Road Maintenance Technical Working Group 2001).

The three early action programs would primarily maintain existing habitat conditions or minimize the effects that development potentially has on salmon and bull trout habitat. These programs would do little to improve previously degraded habitat, but would tend to maintain the opportunity to improve previously degraded habitat. Improvement of previously degraded habitat conditions would be accomplished primarily by the Model's long-term programs. Most of the habitat improvement is expected to be accomplished through the Habitat Funding and Acquisition Program that will be guided in part by the Monitoring and Adaptive Management Program and the Watershed Based Salmonid Conservation Planning Program (WRIA based planning).

8.3.1 Individual Program Findings

Individually applied, the Stormwater Management and Land Management Programs (together with the three long-term programs) would not be expected to maintain all habitat indicators at existing conditions. Each Model program substantially addresses some MRCI considerations, some partially, and some considerations not at all. We do not expect individual implementation of either early action program to independently maintain existing habitat conditions or improve conditions. Individual program implementation would not be consistent with the MRCI Limit by definition[45].

Stormwater Program

Existing habitat conditions would generally be maintained through the Stormwater Management Program in the short term, except for base flows. The Stormwater Management Program would contribute to maintaining water temperature, sediment and turbidity conditions, although water temperatures could be degraded in cases where ground water discharge is substantially affected. It would also generally maintain, but could degrade, chemical and nutrient water quality conditions. The Stormwater Management Program would contribute toward maintaining habitat access, pool quality, off-channel habitat, refugia, and floodplain connectivity. It would not, however, address the large woody debris condition. This program would help to maintain existing road density, drainage network, and forest cover conditions in rural areas, and it would contribute to maintaining riparian reserves. Restrictions provided by the Stormwater Management Program would help to maintain existing habitat conditions in places such as valley bottoms. The Model does not directly address sub-basin-scale protection of base flows, which would rely on jurisdictions to implement regional facilities or other actions.

The Stormwater Management Program relies on other programs (primarily Land Management) to maintain or improve habitat conditions and meet the MRCI Limit. In the long term, flow controls and stormwater CIPs would be expected to improve peak flows and durations. The Stormwater Management Program would allow continued development to degrade base flows. Fish passage conditions would be improved through the capital improvement and habitat enhancement/rehabilitation elements of the Stormwater Program.

Land Management Program

Existing mature riparian forest and immature riparian forest would generally be protected by the Land Management Program, allowing the immature forest to mature over time. The MZ regulations and CMZ designations designed to protect or improve natural stream process would provide this protection. The Land Management Program would not protect existing conditions from degrading in the OMZ where the OMZ is in a forested condition. Potentially, the entire OMZ could be cleared as long as the 65% retention

[45] Item (iii) of Limit 12 of the Final 4(d) Rule states, "NMFS finds the MRCI development activity to be consistent with the conservation of listed salmonids' habitat when it contributes to the attainment and maintenance of PFC."

standard for the entire MZ of a site is met. A substantial portion of chinook-bearing stream area (19.4% of chinook-bearing stream miles) is located in sub-basins designated for agricultural land-use. Habitat Acquisition and Restoration Funding would be necessary to improve previously degraded habitat in these areas. Areas within the MZ that are cleared, but not developed, would generally be protected against new development and retained in a condition that would allow incremental natural reforestation or preserve the MZ area for restoration activities. The Land Management Program would maintain or improve the potential for large woody debris recruitment through riparian protection. In previously developed areas, large woody debris may be improved over time as redevelopment that includes provisions of the Land Management Program occurs. In heavily urbanized areas with little existing functional riparian habitat, MZ regulations would have little effect on stream habitat functions.

The Land Management Program substantially addresses potential development impacts within riparian zones. It would rely on other programs (most notably Stormwater Management) to contribute to the maintenance or improvement of habitat toward PFC, and to meet the NMFS MRCI Limit on a watershed scale. The Land Management Program would gradually improve conditions over the long term, as developing vegetation matures in areas where riparian vegetation was previously cleared but the land not developed. By protecting these areas, the regulations would protect future recovery opportunities (e.g., natural and managed reforestation, in-stream and off-channel restoration, etc.). Some habitat conditions would improve as the MZ vegetation matures

Long-Term Programs

The WRIA Based Planning Program would provide appropriate expert guidance to direct habitat acquisition efforts toward appropriate actions. The Monitoring and Adaptive Management Program would provide the means to learn from early actions and to develop more effective habitat restoration actions over time. Monitoring would provide the information for future evaluation of the appropriate level of funding for habitat restoration. Jointly, these long-term action programs provide the potential for effective habitat restoration appropriate to aid in the restoration of salmon and bull trout populations to harvestable levels.

The three long-term action programs would provide the potential to improve previously degraded habitat as well as protect existing valuable habitat. The Monitoring and Adaptive Management Program is an essential program to ensure that progress is made toward improvement of habitat in previously degraded areas and habitat is maintained within developing areas. The program would provide information and guidance to future habitat protection and restoration actions. Although the role of adaptive management is clearly included in the Model, the process for achieving adaptive management is not included, nor is a process for routine incorporation of this new information into appropriate policy revisions.

The Watershed Based Salmon Conservation Planning and Monitoring and Adaptive Management Programs have the potential to guide effective actions that would contribute to maintenance or improvement of habitat conditions . In particular, these programs are necessary to identify additional regulatory, programmatic, or capital actions that would be necessary in addition to the early-action programs in both the near term and long term. The role of adaptive management is clearly included in the Model; however, the processes for achieving monitoring and adaptive management are not clearly defined.

The Habitat Acquisition and Restoration Funding Program would need to provide much of the funding that is necessary to accomplish habitat restoration. Although there is uncertainty as to the appropriate funding levels, the funding program would provide an accrual of habitat benefits over time. It has the potential to substantially contribute to the salmonid habitat conservation and restoration in the region. Through the Watershed Based Salmonid Conservation Planning Program, appropriate projects can be

selected and funded to improve valuable habitat components. The 1% funding level would provide cumulative benefits over time if allocated in accord with salmonid recovery priorities. Particularly following completion of the WRIA conservation plans, funding should be used for scientifically planned projects. The dependability of the funding commitments under the proposed program relies heavily on the annual reporting requirement and the consequences of non-compliance are unclear. Buying power under the Model could deteriorate over time if unspent Tri-County funds are carried forward into succeeding years without adjusting for inflation.

8.3.2 Individual Program Recommendations

Stormwater Program

Identifying practicable alternatives for maintaining or improving base flows in the Tri-County region would strengthen the Model because the early-action programs would not be likely to maintain base flows. Some alternatives include extended detention and streamflow augmentation using wells, but insufficient information exists on the regional technical and economic feasibility of such practices.

The maintenance or improvement of several PFC indicators relies on jurisdictions to apply the land use decisions element of the Stormwater Program. Specifically, the element requires that jurisdictions use best available science to guide land use planning and zoning decisions. Adding more specific guidance for land use decisions would strengthen the Stormwater Program.

There is a need for a focused assessment involving several years of instream flow monitoring in sub-basins primarily developed under the flow duration standard to confirm that flow duration controls prevent deleterious effects to PFC for peak flows and flow durations.

Land Management Program

The Model requirements apply equally to Puget Sound shorelines and estuaries, as well as to freshwater systems. However, incorporating reasonable and appropriate management objectives and actions that focus on the needs of Puget Sound shoreline habitats would strengthen the Model.

Criteria should be determined for designation and protection of high-priority riparian areas in urban areas. The criteria should include current or potential chinook salmon and bull trout use, land-use, and riparian existing condition characteristics. Where high-priority areas are identified, additional protective measures may need to be defined. This may be accomplished simply by requiring application of a standard greater than the prescriptive urban standard to the sub-basin of concern or protecting such areas through habitat acquisition or conservation easements.

The Model would be improved by inclusion of an agriculture management program that would provide a more consistent and efficient means for jurisdictions to apply for 4(d) coverage. The existing Model requires individual jurisdictions to identify their own programs. The Model does not directly address agricultural activities. However, agricultural activities that meet the definitions of development would be subject to the requirements of the Model. Agricultural land use is addressed through other laws and regulations (e.g., GMA, Fish and Wildlife Habitat Conservation Areas), and the MRCI Limits do not specifically address agriculture. However, farming activities in the Tri-Counties constitute an integral and significant part of the rural and suburban landscape. Attainment and maintenance of watershed-scale PFC in most WRIAs will require jurisdictions to identify programs and regulations to address agricultural activities.

Long-Term Programs

We recommend that the Model include a process for achieving adaptive management in the Monitoring and Adaptive Management Program.

The Model would also be improved by including a process for routine incorporation of new scientific information derived from monitoring and other independent investigations into appropriate policy revisions.

If the Stormwater Management and Land Management Programs are implemented independently, they should incorporate the Watershed Based Salmonid Conservation Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs as proposed in the Model. Only in this manner will improvement of previously degraded habitat conditions toward PFC occur on a broad scale.

Regional monitoring protocols (or a definitive process and timeline for establishing them) should be provided in the Monitoring and Adaptive Management Program to assure that consistent and useful monitoring programs would occur across jurisdictional boundaries. The Model is a regional program that requires a commitment of resources from each participating local jurisdiction, state, and federal entity in terms of number and technical expertise of staff (and support funding).

The Habitat Acquisition and Restoration Funding Program requires additional safeguards to ensure that projects with mixed salmonid and non-salmonid benefits (category 2) are correctly credited toward achieving a jurisdiction's 1% commitment. Furthermore, unspent funds carried forward should be adjusted for inflation to avoid deterioration of buying power.

8.4 SYNERGISTIC EFFECTS OF ALL PROGRAMS AND MODEL CONSISTENCY WITH 4(D) RULE CONSIDERATIONS

The intent of the Model is to protect existing habitat and the potential for habitat restoration in the short term, with the overall objective of restoring habitat to PFC at a watershed scale in the long term.

8.4.1 Synergistic Effects Findings

In most cases, synergy among the Model programs is necessary to maintain existing habitat conditions and improve habitat toward PFC in the short and long term on a sub-basin and watershed scale. Based on an evaluation of MRCI considerations and PFC described above, all of the early-action and long-term programs would be necessary to ensure that most of the MRCI considerations and PFC indicators are addressed by jurisdictions. A single program may, in some instances, substantially address a single indicator or consideration.

In many cases, Model implementation certainty would rely on jurisdictions to demonstrate how they would implement specific elements and programs. Each jurisdiction would specify how they would implement the Watershed Based Salmonid Conservation Planning, Monitoring and Adaptive Management, and Habitat Acquisition and Restoration Funding Programs to ensure watershed-scale protection or improvement of PFC.

We conclude that the Model does not adequately address the Monitoring/Enforcement/Funding MRCI Limit consideration. See recommendations regarding the monitoring element below.

The Model is not intended to, and does not directly address the Water Supply MRCI Limit consideration. Water supply and potential conservation measures are generally not regulated by the counties or local jurisdictions. See recommendations regarding water supply below.

8.4.2 Recommendations

Effective implementation of all programs would be necessary to maintain and potentially improve PFC conditions at a watershed scale.

Certainty of the Model's overall performance relies on jurisdictions to provide implementation details for numerous elements and programs, as identified throughout this review. We recommend that the Tri-County effort coordinate with NMFS and the USFWS (Services) to develop a standardized checklist and template for jurisdictions to complete their individual adaptations of the Model. This would include features needed to provide implementation certainty, such as planning and implementation commitments, adaptation of regulations to local conditions, funding sources, schedules, standards for quantifiable goals, and non-compliance response.

The Model does substantially address 4 of the 12 MRCI Limit considerations, partially addresses 7 considerations, and does not address 1 consideration (Water Supply). Because the Model does not substantially address all of the MRCI Limit considerations, jurisdictions applying for this limit should reference or provide additional programs or other measures that include:

- Protection of isolated wetlands and sensitive areas addressed through existing state and federal laws and regulations;
- Promotion of native landscaping;
- Development of regional monitoring protocols through processes such as Phase I and Phase II NPDES municipal stormwater permits (ideally, specific monitoring protocols, parameters, schedules, and responsibilities would be developed by the Washington Department of Ecology); and
- State and federal land management agencies' should commit to the Land Management Program and Rural 65/10 Residential Site Standard proposed in the Model (or other equally or more restrictive standards), individually or in partnership with local jurisdictions to provide local protection of PFC.

The Model relies on the Monitoring and Adaptive Management Program to validate and adapt its performance. The Model programs should provide specific regional protocols, or identify the process by which regional protocols will be established, so consistent and useful monitoring programs will occur across jurisdictional boundaries. Jurisdictions will also need to provide information on other regulatory programs that are supplemented by the Model, but that are essential to success of the overall conservation program.

In general, the Model programs could be improved by further defining how they will incorporate new internal and external scientific information through the Monitoring and Adaptive Management Program. For example, by stating the frequency and process by which additional literature reviews and scientific evaluations of these concepts will occur. This is done in part in the Regional Road Maintenance Program and in general in the Monitoring and Adaptive Management Program.

The Model programs should include a process to ensure that adaptive management actually occurs on a routine schedule following appropriate guidelines. Providing additional guidance on the frequency of review, and the process for adaptive management review of policies, would improve the Model.

Including sunset provisions for established policies and regulations would be one means of ensuring routine review that could incorporate appropriate adaptive management provisions.

The Model does not address water supply criteria, in part because counties and cities in the Tri-County region have varying degrees of authority and responsibility for water supply. According to Central Puget Sound Regional Water Suppliers' Forum (2001), the region does not currently have a structure or process for making collective regional water resource management decisions that encompasses the complex set of issues, interests, and participants related to domestic water supply and instream flows. It is important to ensure that a process is developed to engage participants, link all ongoing related water elements, and facilitate water management decisions that must be made to address both short- and long-term challenges.

8.5 CONCLUSIONS

It is our conclusion that the Model does contribute to the persistence of existing habitat functions and the improvement of additional habitat functions, where they have been previously degraded. This improvement is likely to provide substantial habitat improvement in the long term. However, we do not have the information available to quantitatively assess the impact of the Model on salmonid populations.

We conclude that the Model is likely to conserve habitat and habitat functions supporting listed salmonid species consistent with the ESA and the NMFS 4(d) Rule for threatened salmonids. The Model and the authority of local jurisdictions is not adequate to directly address all provisions of ESA and the NMFS 4(d) Rule for threatened salmonids.

The three early action programs would primarily maintain existing habitat conditions or minimize the effects that development and local government activities potentially have on salmon and bull trout habitat. These programs would do little to improve previously degraded habitat, but would tend to maintain the opportunity to improve previously degraded habitat. Improving previously degraded habitat conditions would be accomplished primarily by the Model's long-term programs. Most of the habitat improvement is expected to be accomplished through the Habitat Funding and Acquisition Program that will be guided in part by the Monitoring and Adaptive Management Program and the Watershed Based Salmonid Conservation Planning Program (WRIA based planning).

Implementation details appropriate for numerous program elements are not included in the Model. Coordination of the jurisdictions with NMFS and the USFWS (Services) can develop standardized checklist and template to complete individual adaptations of the Model. These would include features needed to provide implementation certainty, such as planning and implementation commitments, adaptation of regulations to local conditions, funding sources, schedules, standards for quantifiable goals, and non-compliance response.

The funding that is necessary to accomplish habitat improvement and restoration would be provided by the Habitat Acquisition and Restoration Funding Program and federal funding sources. Although there are substantial uncertainties as to the appropriate funding levels and mechanisms, the funding program would provide an accrual of habitat benefits over time.

8.6 LIMITATIONS OF THIS BIOLOGICAL REVIEW

This Biological Review evaluates the general expected effects of the Model in the Tri-County region. The Biological Review does not provide an in-depth analysis of implementation of the Model in specific watersheds and jurisdictions; rather, it forms a basis upon which local jurisdictions would build their own analysis. The specific effects of the Model on local PFC would require jurisdictions to analyze and report

local baseline habitat conditions, physical and geological constraints, and detail on the jurisdiction's proposed adaptation of the Model (particularly the long-term programs).

This review relies on NMFS and USFWS MPIs as the best available published guidance for evaluation of program effects. The MPIs are a coarse set of criteria, designed to be adapted as necessary to specific regions and species. The MPIs used for this analysis were developed for higher-elevation headwaters streams. PFC for Puget Sound lowland streams have not been defined. The MPI criteria used in this biological review were assumed to be generally applicable to Puget Sound lowland streams.

The effectiveness of the Model programs at addressing habitat and population concerns at larger scales (watershed, sub-basin, WRIA) is yet relatively untested. The conclusions from the sub-basin analysis are generally representative of the widely varying land-use characteristics within the three counties. The effects of the Model regulations are often dependent on these existing land-use conditions. However, other physical characteristics of the sub-basins within the three counties vary outside the characteristics of the sub-basins covered in our analysis. Therefore, this analysis focuses primarily on reach level effects due to the uncertainty of predicted spatial effects at larger scales.

Because most concepts of the Model depend on local studies, the analysis included only limited sources independent of those reported in the Model itself. In many cases, the proposed concepts are too contemporary to have been empirically evaluated. Literature was cited where feasible, but many concepts and programs were analyzed based on current, widely accepted biological and engineering principles, with the explicit expectation that the program elements would be specifically evaluated and improved over time under the long-term action programs.

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