Table of Contents

A. LETTER OF COMMENDATION FROM WASHINGTON STATE DEPARTMENT OF FISH AND WILDLIFE

State of Washington
DEPARTMENT OF FISH AND WILDLIFE

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Main Office Location: Natural Resources Building • 1111 Washington Street SE • Olympia, WA

January 25, 2005

The Honorable Steve Mullet
Mayor, City of Tukwila
Chair, Green/Duwamish Forum
Office of the Mayor
6200 Southcenter Boulevard
Tukwila, Washington 98188

Dear Mayor Mullet:

The Washington Department of Fish and Wildlife (WDFW) commends the excellent work completed in WRIA 9 and your commitment to salmon recovery. The active participation of 15 local governments, Tacoma Public Utilities, and the citizens of King County is a substantial step toward salmon recovery and, more generally, for assuring that future generations can continue to enjoy the natural resources of King County. The WRIA 9 Technical Committee has provided analyses that help define for you the technical basis for salmon recovery planning. The scientific foundation used by the WRIA 9 Technical Committee for establishing Viable Salmonid Population (VSP) goals and objective, as well as the necessary future habitat conditions, follows guidance that was developed by the Puget Sound Technical Recovery Team (TRT), National Oceanic and Atmospheric Administration (NOAA) Fisheries, and Shared Strategy for Puget Sound.

The WDFW supports the WRIA 9 Technical Committee's preliminary planning ranges and mid-point for spawning abundance. WDFW concurs with the use of the TRT population viability calculations at approximately 17,000 as the lower bound on adult spawners (equilibrium abundance) with the upper limit near 37,000. WDFW also concurs that using a population mid-point of 27,000 spawning adults for equilibrium abundance is a reasonable preliminary planning target. Refinement of the planning target can and should occur as additional analyses are completed. As noted in WRIA 9 documents, productivity, diversity, and spatial structure are also important determinants of population viability, and WDFW is prepared to discuss these in greater detail with appropriate technical staff.

Perhaps more importantly, the identification of key areas for restoration efforts is a critical step in the development of a recovery plan. WDFW understands that WRIA 9 technical staff have prioritized three areas: (1) the Duwamish Estuary transition zone in the vicinity of River Miles (RM) 5.5 to 7.0; (2) spawning and habitat in the Middle and Lower Green sub-watersheds; and

(3) rearing habitat in the Middle and Lower Green River. WDFW agrees that these should be focal points for restoration efforts, but also wishes to reemphasize the importance of protecting existing habitat throughout the watershed. As noted in WRIA 9 documents, nearshore areas in King County are also important for the recovery of many populations of Puget Sound chinook.

WDFW believes that hatcheries can be an effective tool to help achieve conservation and harvest objectives in WRIA 9, but only when used in conjunction with habitat protection and restoration. The federally sponsored Hatchery Scientific Review Group (HSRG) and co-managers have developed tools to identify scientifically defensible combinations of habitat improvements, harvest constraints, and hatchery programs that are consistent with policy objectives and constraints. We believe that application of these tools might help develop a recovery plan that successfully integrates hatcheries, harvest, and habitat, and would be pleased to provide a workshop for WRIA 9. WDFW also continues to evaluate and implement improvements to hatchery programs, including: (1) incorporation of natural-origin broodstock to maintain population fitness; and (2) improved release strategies to reduce the potential for competition in the estuary.

Please contact Jim Scott at (360) 902-2736 if you wish to schedule a workshop on all-H integration or Bob Everitt (425) 775-1311 if you have more general questions regarding WDFW's perspectives on salmon recovery in WRIA 9.

Sincerely,

Jeff P. Koenings, Ph.D.
Director

cc: The Honorable Rebecca E. Clark
The Honorable Dow Constantine
Doug Osterman, Green/Duwamish Watershed Coordinator
Jim Kramer, Shared Strategy
Margaret Duncan, Shared Strategy
Mary Ruckelshaus, NOAA Fisheries
Isabel Tinoco, Muckleshoot Tribe
Jay Zischke, Suquamish Tribe
Bob Everitt
Phil Anderson
Lew Atkins
Greg Hueckel
Marnie Tyler
Kirk Lakey
Jim Scott

B. WRIA 9 COMMITMENTS AND ASSURANCES

Commitments and Assurances

What expectations are requested of federal and state governments and other non-local government entities in exchange for implementation of the plan by local governments?

What type and level of commitments are recommended for local governments to implement the plan?

Introduction

When species are listed under the Endangered Species Act (ESA), federal agencies are required to ensure any actions they fund, permit or carry out are not likely to jeopardize the species' continued existence or destroy or adversely modify its critical habitat. Federal agencies must consult with the listing agency (NOAA Fisheries or U.S. Fish and Wildlife Service) regarding actions they take that "may affect" the listed species or its critical habitat. Actions that may affect but are "not likely to adversely affect" the species undergo an informal consultation, while those that are likely to adversely affect the species or its critical habitat must undergo more lengthy formal consultation. The ESA also prohibits the "take" of listed species, either through section 9 (for an endangered species) or through section 4(d) (for threatened species).

Private citizens, landowners, businesses and local governments can all be affected by the federal consultation requirement or the ESA prohibition of take. For example, ESA consultations can affect the time it takes to issue a permit, fund a project, or complete an action when a federal agency is involved. Consultation might also affect the conditions on a permit or funding, or the manner in which a project is completed. The take of a listed species can occur as a result of many of the everyday activities carried out in a watershed, resulting in an ESA violation.

Implementation of the WRIA 9 Salmon Habitat Plan will offer many benefits to both fish and humans. But to ensure implementation, local governments will need to offer some level of commitment. In exchange for these commitments, local governments will have expectations from other entities. In particular, local governments hope to negotiate potential benefits and assurances with the federal and state governments. In addition, there are potential actions that federal and state agencies, the co-managers of the fisheries resource, and other non-local-government entities can choose to implement that will help benefit salmon and people in WRIA 9. Clearly, these benefits, expectations, and commitments are all intertwined and interconnected. There will need to be a dialog among appropriate parties to define and refine the final commitments and expectations that will benefit salmon recovery. This public review draft offers recommendations in both areas to begin the dialogue with the appropriate parties to obtain a greater level of assurances.

Local jurisdictions and stakeholders in the Green/Duwamish and Central Puget Sound Watershed (WRIA 9) have a strong history of working together to conserve salmon habitat. The broad level of commitment that already exists can be shown in the following three examples. First, 16 local governments in the watershed are beginning their fifth year of a five-year interlocal agreement to

jointly fund planning for protection and restoration of salmon habitat across the watershed. Second, local jurisdictions and the U.S. Army Corps of Engineers have been cooperating in the Green-Duwamish Ecosystem Restoration Project. Third, local governments have designated King Conservation District grants to fund shared watershed priorities through habitat projects, technical studies, and stewardship opportunities.

In order for the watershed to reach its goals, local governments and participating stakeholders must make some type of commitment to implement actions proposed in the plan. Commitment can come in several forms and at varying levels. Before making any commitment, potential implementers will need to evaluate the actions to which they are committing. Potential implementers will want to know what benefits they will receive if they do make a commitment and what federal and state agencies can offer to support such commitments. This will continue to be an iterative discussion among the WRIA 9 Steering Committee, WRIA 9 Forum, local governments, regulating agencies, citizens, businesses, Puget Sound Shared Strategy, and other interested partners leading up to plan approval and ratification. From the federal agency standpoint, their ability to provide certainty and regulatory relief is based on several factors:

1. The comprehensiveness, level of detail and scientific certainty of results proposed in a recovery plan,

2. Comprehensiveness and certainty of commitments for implementation,

3. Demonstrated progress in implementation of actions called for in the Plan, and

4. Improved status/trends for populations listed under the ESA.

Like climbing the rungs on a ladder, the more progress that is made toward achieving the four criteria, the higher the level of certainty or regulatory relief that could be offered. At the time of the anticipated adoption of the plan by the federal agencies, the factors mentioned above will only be partially met. It is anticipated that the plan will actively evolve over time and that substantial progress could be made on all four factors over the first years of implementing the plan.

What expectations are requested of federal and state governments and other non-local government entities in exchange for implementation of the plan by local governments?

In exchange for making commitments to implement the plan, local governments may want to seek to negotiate benefits and legal assurances with federal and state regulating agencies. One avenue to start that discussion is through the Puget Sound Shared Strategy.

The Puget Sound Shared Strategy is a collaboration among several levels of government, including federal agencies responsible for administering the Endangered Species Act, the state, and the tribes, as well as other stakeholders. Shared Strategy intends to develop a recovery plan at the Puget Sound scale that incorporates the WRIA 9 plan, similar efforts from groups in other watersheds, and plans for harvest and hatchery management from the co-managers of the fisheries resource (i.e., the tribes and the state). This intergovernmental collaborative

development of the recovery plan for a listed species is unique in the country. Shared Strategy appears to be the venue through which the regulating agencies will engage in plan review and discussion of legal and other assurances and benefits for local governments. Because local governments are participating in the planning, the Steering Committee recommends that they set forth requests and expectations for what might be appropriate assurances and benefits in exchange for supporting the recovery plan that the Endangered Species Act requires the federal government to develop.

In addition, local governments alone will not have the resources or the opportunity to fully protect and restore Chinook salmon habitat in WRIA 9. Therefore, the implementation partnership will need to extend throughout the public sector to the private and non-profit sectors as well in order to reach the ultimate goal of salmon recovery.

Expectations for Potential Benefits that Could Be Negotiated with Regulating Agencies

It is not clear at this time exactly what assurances -- whether legal, funding, regulatory, or other -- the federal government could or will provide for implementation of salmon conservation plans at the watershed level. Because the federal and state regulating agencies and the co-managers are participating in the Puget Sound Shared Strategy, that may be the appropriate forum where the discussion on these proposed assurances can occur.

Interests in the business community and local governments would like several options considered as incentives from the federal government for implementing the recovery plan.

1. Programmatic consultation on the issuance of the recovery plan so that subsequent actions by local governments and business that require review by the Services can get expedited treatment.

2. A policy statement that the Services will not initiate enforcement actions against parties who are making reasonable good faith efforts to act in ways consistent with the recovery plan. This would not preclude citizen suits but might discourage them.

3. Adopt reasonably "may affect" and "Not likely to adversely affect" thresholds for ESA consultation on actions consistent with the recovery plan. For example, NOAA Fisheries could adopt a policy that small land development projects that are covered by CWA Section 404 nationwide general permits or regional general permits and are consistent with the recovery plan would be presumed not to have more than de minimus effects on ESA-listed salmon and therefore no ESA consultation is needed unless the Corp decides the project "may affect" salmon in more than a de minimus way.

4. Adopt a policy that projects consistent with the recovery plan which "may affect" salmon are presumed to be "not likely to adversely affect" ESA listed salmon unless either the Corps or NOAA Fisheries finds that extraordinary circumstances cause significant adverse effects.

These are just several examples for consideration and significant research and policy analysis will be required to determine if these suggestions are possible and what conditions need to be met for them to become an option used by the federal government. It must also be recognized that there may also be new types of legal assurances that the federal government could develop and offer as well.

It should be proposed that assurances and grants in return for commitments to implement the plan may be appropriate through federal and state laws and programs other than the Endangered Species Act, e.g., under the Clean Water Act and through National Pollution Discharge Elimination System stormwater permits. The state could take into account the tangible results of plan implementation that support meeting the requirements of other laws and regulations such as through updates of critical areas ordinances, comprehensive plans, and zoning ordinances required under the Growth Management Act and through shoreline master plans required under the Shoreline Management Act. For example, it is recognized that effective implementation of the GMA goes hand in hand with commitment to plan implementation and that local governments with robust land use policies and programs receive "credit" for this commitment as well.

In addition, it is recommended that opportunities to receive federal and state grants through the Salmon Recovery Funding Board process could be linked to plan implementation, and that other grants such as the Centennial Clean Water Fund and the Washington Wildlife and Recreation Program could offer bonus points for projects that implement the plan.

Potential Actions to Be Implemented by Non-Local-Government Entities

Local governments have neither the means nor the authority to implement all the actions necessary to protect and restore salmon habitat in WRIA 9. Recovery of salmon will be undertaken by a broad partnership that reaches beyond local governments to include citizens, homeowners, community groups, non-profit agencies, businesses, developers, public agencies, and the co-managers. The comprehensive action lists and the project list as well as the proposal on monitoring and measures provide a wide range of recommendations that look to a wide range of implementers. For example: NOAA-Fisheries and the co-managers could conduct validation monitoring (i.e., are Chinook recovering at expected levels across the Puget Sound region). The U.S. Army Corps of Engineers could continue its efforts to fund and implement the Ecosystem Restoration Project The Washington Department of Transportation could further its work to minimize impacts of road widening and bridge building on salmon habitat. Non-governmental organizations could implement particular habitat improvement and stewardship projects. More developers could design and build low-impact developments.

Seeking Support from Non-Local Government Entities for Plan Implementation

To acknowledge the need for participation by public agencies, businesses, and non-governmental organizations in order to implement particular actions and monitoring tasks, it may be appropriate to seek a show of support such as through public-private partnerships, funding and assistance from foundations, plan endorsement at public review sessions, assistance with public outreach, and political support. Steering Committee members have noted that since junior taxing districts need to be in compliance with local governments, it can be expected that water and sewer districts would implement the plan through contract relationships with utilities.

Other possible tools to demonstrate support of plan implementation include:

- Letters or memoranda of understanding from agency heads or program managers to formally consider the WRIA 9 plan as guidance when fulfilling their related responsibilities
- Commitments from agencies and other partners to implement particular actions or monitoring tasks
- Legislative or regulatory changes as requested in specific plan actions
- Budget and work program line items to fulfill specific plan actions.

A show of support and participation by public agencies and other non-local-government entities could be sought through various means such as:

- Listing the actions and monitoring tasks requested in the draft plan;
- Letters to appropriate potential partners from the WRIA 9 Forum;
- Negotiations with appropriate parties through the Puget Sound Shared Strategy process that includes federal and state regulating agencies, co-managers, local governments, and other partners;
- Working with state legislators and members of Congress; and
- Requests from citizens, community groups, business, and other non-government partners to appropriate potential partners.

Neither of these lists is definitive; rather, the purpose is to generate ideas to build support for a broader WRIA 9 partnership.

What type and level of commitments are recommended for local governments to implement the plan?

The WRIA 9 plan has been developed through a collaborative effort among 16 cities, two counties, scientists, citizens, representatives from business and community groups, and public agencies. The planning work has been funded by 16 local governments, and it is anticipated that local governments will have a key role in implementation of the plan as well.

Local jurisdictions and other WRIA 9 partners will be expected to make commitments to implement actions and monitoring over the 10-year plan horizon. In addition, longer term actions (10-20 years out) may not have commitments now, but there needs to be a process to line up commitments in the future.

Before commitments can be finalized, this plan will continue to evolve through the following stages: input and feedback received during the current public review process; discussion and approval by the WRIA 9 Forum; and review and ratification by local jurisdictions. As discussed earlier in this chapter, conversations and negotiations with regulating agencies (possibly through

Puget Sound Shared Strategy) for potential negotiated benefits and assurances will be critical to determining the type and level of commitments acceptable to local governments.

What Is Meant By Commitments

Puget Sound Shared Strategy has defined commitment as "a statement of the willingness of an entity or person to implement an action or set of actions within a designated timeframe. Examples of ways to demonstrate commitments include:

- Past history of commitments -- what has already been done on behalf of salmon recovery?;
- Clear action plan describing how and by whom selected projects will be implemented;
- Budgeting for specific actions or projects;
- Incorporating salmon recovery actions into local capital improvement projects;
- Passing a formal resolution pledging to pursue salmon recovery goals; and
- Passing regulations that are consistent with local salmon recovery goals."[1]

Three main areas in which individual local governments will need to determine what role and commitment they want to make towards implementation are:

- Continued regional collaboration on tracking, assessing, evaluating, and communicating implementation progress and securing funding;
- Implementation of actions at the landscape and site-specific levels proposed in the comprehensive and project lists; and
- Monitoring of individual actions and contributing data and resources to the evaluation at the larger scale.

Examples from Other Similar Planning Efforts

It is useful to review briefly how other watershed and basin protection and restoration groups have chosen to structure commitments. The level and type of commitments cover a continuum from no formal commitments to signed concurrence plans. Starting at the low end of the continuum, implementation is informal and left to the discretion of individual implementers. At a step up on the continuum, implementers made commitments to coordinate with other agencies where needed to carry out actions. The next step shows allocation of existing funding, staff, and other resources through budgets and work programs. This demonstrates commitment without necessitating formal agreements. One step more formal is written implementation plans in which implementers individually or together specified how they would implement their actions. The

[1] Shared Strategy for Puget Sound, April 2004. Commitments and Conditions. Seattle, WA

high end of the commitment continuum lists signed or adopted concurrence plans in which implementers agreed to execute specified actions in their area or under their authority. Because the plans reviewed here are in varying stages of ratification and implementation and because accountability has not always been considered, it has been difficult to do an analysis of which type of commitment has been most successful. Generally speaking, when no formal commitments followed plan commitment, implementation has been difficult to track and less successful, while the more formal or stronger the commitment, the more likely the plan is to be carried out.

Expectations from Puget Sound Shared Strategy

Because Shared Strategy is the venue through which the regulatory agencies are engaged in plan review, it makes sense to review what specifically they are seeking as commitments. Shared Strategy has proposed the following as a mechanism to move the discussion forward.

Initial Steps for Federal Certainty

The recommendation for discussion is to create milestones to review and evaluate progress with the possibility of increasing federal certainty or regulatory relief at each milestone. A staged review of progress and the provision of assurances would need the flexibility to provide support for the whole region, individual watersheds and specific sectors of the region. Some individual sectors or watersheds may be further along then others in their understanding and commitment to address the threats to the salmon and they should be rewarded with additional assurances.
As a first step, upon the adoption of the Puget Sound recovery plan by the federal services, an agreement could be signed by the federal agencies and the State of Washington for the conservation and recovery of the salmon. “Conservation agreements” are not specific to the ESA but provide a means to formalize shared understanding of commitments that could support implementation of the plan.

The conservation agreement would acknowledge that the Puget Sound recovery plan with its implementation commitments is the agreed upon approach for achieving recovery. The conservation agreement would identify key measures that would be monitored for success, the process for adapting to new information and the initial milestones over a 10 year period where progress and results would be evaluated. The agreement would also state the intention of the state and federal agencies to jointly pursue funding for local communities. Finally, the agreement could indicate the support of the recovery plan actions as the appropriate solution for the area in the event of third party lawsuits. The agreement would identify review points at specific time intervals, like at three, five and ten years. At each review point the progress would be evaluated for each watershed, fish population and the whole region. Based on the four factors mentioned in the previous section, the federal agencies would determine if additional assurances or regulatory relief could be provided (Shared Strategy, 2005).

Commitments from Local Governments

Five options are provided below which offer a continuum of level of commitment. These are not mutually exclusive options.

1. Local governments implement the Plan as they choose; no formal commitments to actions or regional process	2. Local governments continue coordinated watershed-wide decision-making process and pooled funding for operating needs and capital investments, possibly through an interlocal agreement	3. City/county councils pass resolutions to formally consider the Plan as guidance and best available science for capital improvement programs, critical areas ordinances, comprehensive plan updates, National Pollutant Discharge Elimination System permits, and shoreline management plans	4. City/county councils formally commit to implementing particular actions by signing concurrence plan or interlocal agreement. Actions could be undertaken: -By individual jurisdiction (e.g., specific habitat projects) -Cooperatively by sub-basin (e.g., joint hiring of basin steward) -Watershed-wide (e.g., collaborative analysis of effectiveness monitoring)	5. City/county councils ratify or adopt entire Plan as policy and implement through local ordinances and capital improvement programs

The first two options at the lower end of the continuum (no formal commitments and coordinated regional process) are probably insufficient to obtain the level of assurances that participating partners desire. The middle option of local government councils passing resolutions to formally consider the plan as guidance (3, above) is in all likelihood a minimum commitment to participate. Either of the last two options along the continuum – local government councils commit to implement particular actions or ratify/adopt the entire plan as policy will in all likelihood result in the greatest level of assurances form the federal and state regulatory agencies as they provide the greater level of certainty for recovery.

The more assurances desired from the federal government, the stronger the commitments will need to be. As a corollary, the stronger the commitments implementers are willing to make, the more benefits and rewards they should accrue. The level of commitment could vary by type of action, e.g., specific capital improvement projects could merit formal concurrence commitment while land use policies might be considered as guidance for implementation of policies and programs required under other laws.

Next Steps

As stated earlier, this is just the beginning of the discussion of expectations and commitments. The discussion will continue during the current public review process and when the WRIA 9 Forum and local governments formally review the plan in 2005. In addition, conversations will need to progress with the Puget Sound Shared Strategy, federal and state agencies, the co-managers, and other partners.

References

Shared Strategy for Puget Sound, April 2004. Commitments and Conditions. Seattle, WA

Shared Strategy for Puget Sound, January 2005. Federal Assurances under the Endangered Species Act. Draft Platform Statement for Shared Strategy Summit.

C. PUBLIC INVOLVEMENT ACTIVITIES IN 2004-2005

1. Public Involvement Goals

In January 2004, the WRIA 9 Steering Committee approved the Public Involvement Plan to support work on the Salmon Habitat Plan. (The entire Public Involvement Plan is available on-line at: http://dnr.metrokc.gov/Wrias/9/Public_Involvement_Plan_2004.pdf.)

The goals of public involvement were to:

- Inform people about salmon habitat problems and the evolving response to those problems in their watershed
- Incorporate public suggestions, local knowledge, and citizen volunteer efforts into the WRIA 9 Habitat Plan to maximize the likelihood that the Plan can and will be implemented
- Encourage citizens to get directly involved in helping salmon habitat and encourage them to support actions carried out by local governments

2. Public Involvement Guidelines

The Public Involvement Plan listed the following guidelines that were followed as much as possible by staff in conducting public outreach:

- Seek input before decisions are made.
- Ask questions that the public can answer (topics such as community priorities) rather than detailed scientific/technical questions. (We should be open, however, to technical information offered by the public if we can verify it [e.g., fish presence in a certain stream]).
- Focus on decisions and key issues, rather than feelings, when asking for input.
- Ask only when there is a clear process for gathering input, collating or summarizing it, and presenting it to decision makers. This guideline is particularly important if scientific conclusions differ considerably from social and economic values.
- Ask only when decision makers can and will consider public input and apply it to the decision making process.
- Inform the public how their input was received, how it was considered, and what decisions were made. This guideline is particularly important if scientific conclusions differ considerably from social and economic values.
- Public information/education about the watershed ecosystem and how people are part of it is an essential part of public involvement because:
    - It can help motivate participation (either personal action or planning input)
    - A basic understanding of the scientific/technical problems will help people offer good input
- Communicate simply and succinctly, at a level to ensure that basic scientific information will be meaningful to the average person.

- Habitat planning is not inherently exciting. Those we contact should be encouraged to provide input but if they are not interested, an option should be provided: personal behavior change. Moreover, people's actions tend to shape how they view themselves and what they care about. If we are successful in encouraging this change, it increases the likelihood that asking for planning input at a later date will result in planning participation. Finally, persuading people to make changes in their daily lives requires explaining the habitat problems and what causes them.

- Wherever possible, approach people using existing forums (e.g., Chambers of Commerce, service clubs, regular community events, etc.).

- Emphasize the value of the Habitat Plan in terms of improved water quality, healthier environment, and greater quality of life in our streams, rivers, and the Puget Sound shoreline, not just for today but for future generations.

The Public Involvement Plan noted that:

- While decision makers should use public input, they are neither bound by it nor limited to it. The public should understand that decision makers will make choices in light of scientific facts, scientific uncertainty, fiscal constraints, legal requirements, and public input. Public input also will come through the participation of every Steering Committee member.

- Equally important, decision makers should recognize that citizens who offer their opinion will want to know how the input was used and why decision makers make the choices they do.

Based on the goals and guidelines, the Public Involvement Plan identified potential audiences/participants. While the general public was the ideal audience, only smaller subsets of the public could be reached using mass media techniques given cost and fragmentation of the market. Consequently, staff concentrated on reaching specific audiences that were believed to be more likely to be interested and take the time to either offer comments or take steps in their own lives to help salmon habitat. Because of limited time and resources, suggested audiences/participants were grouped in tiers by priority.

3. Public Involvement Activities in 2004 to Develop the Draft Salmon Habitat Plan

The following list summarizes the outreach activities carried out in 2004 pursuant to the recommendations of the Public Involvement Plan:

Public Open Houses and Workshops to Develop the Draft Habitat Plan

- Workshop #1: July 8, 2004 -- topic: introduction to watershed habitat planning

- Science Seminar: July 29, 2004 -- presentations on the latest findings about salmon habitat needs in the watershed

- Workshop #2: October 12, 2004 -- topics: brainstorm possible actions to protect and restore salmon habitat; ranking of feasibility and effectiveness criteria

- Vashon/Maury Island Workshop: November 3 -- topics: brainstorm possible actions to protect and restore salmon habitat with a focus on the Puget Sound marine nearshore

- Workshop #3: November 30, 2004 -- topic: evaluating pros/cons of possible habitat actions

Postcard Notification

In September 2004, postcard notices announcing the October and November public meetings and the on-line survey were mailed to 6,540 addresses. The mailing list was drawn from the King County Assessors database and included nearly all people who own property on the Puget Sound shoreline or on freshwater rivers, major streams, and lakes in WRIA 9. Recipients also included people from a variety of King County Water and Land Resources Division mailing lists.

E-mail Notification

Multiple e-mails were sent out beginning in July 2004 to notify a mailing list of citizens who had asked to be notified of information and comment opportunities on the Habitat Plan (the initial list was about 125 names long and grew to over 200 by the end of the year).

Coverage/Outreach

- King County Journal, "Salmon Recovery Workshop Tonight," July 8, 2004
- Seattle Post-Intelligencer, “Getting Involved,” July 28, 2004
- Daily Journal of Commerce, “Two-year salmon study completed,” August 3, 2004
- KPLU radio story, "Changed River," August 4, 2004
- Renton and Kent Reporters, "Salmon plan," October 6, 2004
- Seattle Times, “Here and Now Column: Salmon Habitat Workshop,” October 11, 2004
- Vashon-Maury Island Beachcomber, "School of Fish News," October 27, 2004
- Vashon-Maury Island Loop, "Salmon Habitat Workshop," November 3, 2004
- Voice of the Valley, "Salmon Habitat Plans under development," November 23, 2004
- King County Journal, "Workshop, Open House Focus on Salmon Habitat," November 28, 2004
- KPLU radio story, “Salmon Plan,” November 29, 2004

Newsletter Articles

- Fall 2002 “Downstream News” newsletter from King County Water and Land Resources Division
- Fall 2003 “Downstream News” newsletter from King County Water and Land Resources Division
- Spring 2004 “The Conservation Connection” newsletter from King Conservation District
- October 2004 Kent Chamber of Commerce newsletter (linked to article on web)
- Fall 2004 “Downstream News” newsletter from King County Water and Land Resources Division
- November 2004 City of Kent Newsletter

Cable Television Readerboard Announcements (prior to most of the meetings)

- Channel 77 (Puget Sound Access)
- City of Auburn
- City of Burien
- City of Enumclaw
- City of Federal Way
- City of Renton

Web Presence

All outreach events and opportunities were regularly posted on WRIA 9 web page: http://dnr.metrokc.gov/Wrias/9/index.htm (as of January 2005, the WRIA 9 web site was ranked #2 out of 1.3 million on Google when searching for "salmon habitat")

About half of the cities in WRIA 9 and King County included meeting notice information on their web calendars or home pages.

The website includes nearly all of the scientific materials and planning documents generated during the development of the Habitat Plan in 2002-2004.

On-line Survey

To encourage people to comment who were not interested in or able to attend an open house or workshop, an on-line survey was created, extensively beta-tested, and went live on September 12, 2004 and used through the end of 2004. It was filled out on the Internet by 106 persons and another 3 persons filled out paper copies. No one complained about its length or any difficulties experienced in filling it out on-line. The survey included questions intended to gauge knowledge and opinions. Some of the information was intended for use in developing the draft Habitat Plan recommendations while other information was collected for future use in analyzing how to explain the resulting plan.

Watershed Science Seminar Video

The watershed science seminar on July 29, 2004 was videotaped. Three of the most accessible presentations were edited into a one-hour video – "Hot Science, Cool Fish" -- with explanatory captions and cutaways to views of the watershed. The video announced the October 12 and November 30 public meetings.

This video was distributed to city and county cable channels and was broadcast well over 100 times during October – December on the following channels during prime viewing times to snag the channel surfer:

- Puget Sound Access, Channel 77
- City of Auburn, Channel 21
- City of Burien, Channel 21
- City of Enumclaw, Channel 21
- City of Kent, Channel 21
- City of Renton, Channel 21
- King County, Channel 22

Fact Sheet for Jurisdictions

City-specific fliers on the planning process were distributed to cities in spring 2004 for distribution (offered to all cities but provided only to those who reviewed and edited them):

- City of Algona
- City of Auburn
- City of Burien
- City of Enumclaw
- City of Normandy Park
- City of SeaTac
- City of Tukwila

Signage

Temporary plastic signs (about 150) announcing the watershed planning process and encouraging salmon-friendly behavior were placed in parks and other public places next to rivers, stream crossings, and the Puget Sound shoreline in August and September 2004:

- King County
- Tukwila
- Auburn
- Normandy Park
- Des Moines
- Vashon-Maury Park District
- Kent
- Renton
- Burien
- SeaTac

City Council Briefings

- City of Algona, April 27, 2004
- City of Auburn, September 7, 2004 (televised on City cable channel 21)
- City of Burien, March 15, 2004 (televised on City cable channel 21)
- City of Enumclaw, October 2003
- City of SeaTac, April 13, 2004
- City of Normandy Park, April 13, 2004
- City of Tukwila, March 1, 2004
- King County Council, April 12, 2004 (televised on County cable channel 22)

Presentations to Community Groups

- South King County Chapter of Puget Sound Anglers, February 11, 2004
- Auburn Rotary, June, 2, 2004
- Green River Community College, October 12, 2004
- Auburn First United Methodist, October 19, 2004
- Washington State University Cooperative Extension Salmon Class, November 10, 2004
- Fauntleroy Watershed Council, November 10, 2004
- Auburn Sunrise Kiwanis, November 17, 2004
- South King Housing Issues Group of the Master Builders Association, November 18, 2004

Tabling at Community Events

- Tukwila Backyard Wildlife Festival, May 1, 2004
- Covington Drinking Water Festival, May 8, 2004

- Kent Fishing Experience, May 15, 2004
- Auburn Clean Sweep, June 5, 2004
- Steel Lake Fishing Derby, June 12, 2004
- SeaTac International Days, June 27, 2004
- Covington Days, July 24, 2004
- Enumclaw Salmon Festival, October 16, 2004
- Duwamish Superfund Annual Community meeting, October 21, 2004

Elected Official Outreach

Continued and expanded state and local support for watershed habitat protection and restoration is a priority. To keep elected leaders informed about the work of the Habitat Plan, WRIA 9 teamed up with the volunteer group LightHawk to take legislators and local elected officials on flights of the watershed. In December 2003 and July 2004, one-hour watershed flights gave 12 elected officials the opportunity to see for themselves the patterns of land use and locations of salmon habitat in the watershed and were preceded by briefings on the ground on WRIA planning.

4. Public Involvement Activities in 2005 to Review and Revise the Draft Salmon Habitat Plan

The following list summarizes the outreach activities carried out in 2005 pursuant to the recommendations of the Public Involvement Plan to review, revise, and improve the Draft Salmon Habitat Plan:

Public Review Period and Notification of Release of Draft Salmon Habitat Plan

In January 2005, a 45-day public review period was decided on for the Draft Salmon Habitat Plan. It would begin on Thursday, March 10, the date of release for the Draft Plan and would continue through Monday, April 25. The dates for three open houses/public meetings were also identified: March 22 in Renton, March 23 in Auburn, and March 31 on Vashon Island. Meetings were scheduled early in the review period to maximize the opportunities for publicity (it is easier to get media attention for public meetings as events rather than the beginning of comment periods) and provide more time for people to comment after they had been introduced to the Draft Plan at the meetings.

Postcard Notification

In late February 2005, postcard notices announcing the public review period, three public meetings, and on-line comment form were mailed to 6,550 addresses. The mailing list was drawn from the King County Assessors database and included nearly all people who own property on the Puget Sound shoreline or on freshwater rivers, major streams, and lakes in WRIA 9. Recipients also included people from a variety of King County Water and Land Resources Division mailing lists.

E-mail Notification

Multiple e-mails were sent out to notify a mailing list of citizens who had asked to be notified of information and comment opportunities on the Habitat Plan (approximately 200 persons). The identical notice was mailed to about a dozen persons who requested mailed, rather than e-mailed notification. These e-mails included:

- Advance notice of the comment period and meeting, January 20, 2005

- Announcement of release of the Draft Salmon Habitat Plan, beginning of comment period, and public meetings, March 10, 2005

- Announcement of availability of initial public comments and reminder of two weeks remaining in comment period, April 11, 2005

Letter Notification

Some proposed projects in the Draft Salmon Habitat Plan would require the participation or potentially affect private property landowners. To personally notify the property owners (other than those already aware of the proposed projects due to contacts with local government staff), parcel searches were conducted using King County iMap and letters were sent to:

- 31 business owners/tenants along the Green/Duwamish in Tukwila (March 11)

- 30 property owners along the Duwamish on 42nd Ave. S. in Tukwila (March 11)

- 24 property owners on Vashon/Maury Island (March 18)

Newspaper/Newsletter Coverage

Numerous news releases, calendar notices, and op-eds tailored to specific communities were prepared and distributed to a dozen daily and weekly newspapers and newsletters covering the communities in the WRIA 9 watershed. Not all used the materials provided but the following coverage resulted:

- Auburn Reporter, "You Can Help Make a Healthier Watershed" op-ed and calendar notice "Time to Comment on Fish Program," March 9, 2005
- South King Housing Issues E-newsletter, March 11, 2005
- Kent Reporter, "You Can Help Make For a Healthier Watershed" op-ed, March 16, 2005
- Renton Reporter, "You Can Help Make a Healthier Watershed" op-ed, March 16, 2005
- City of Burien newsletter, March 2005
- Highline Times/Des Moines News, "Public May Comment on Salmon Plan at Open Houses" article and community calendar notice, March 16, 2005
- Seattle Post Intelligencer, "Getting Involved," March 16, 2005
- Voice of the Valley, "Public Asked for Help with Draft Salmon Habitat Plan," March 16, 2005
- Seattle Times, Here & Now calendar notice, March 22, 2005
- Vashon-Maury Island Beachcomber, "Salmon Habitat Plan: Vashon is Key to the Kings," March 23, 2005
- The Loop (Vashon-Maury Island), March 23, 2005
- KPLU radio news story "Salmon Plan," March 24, 2005, http://www.publicbroadcasting.net/kplu/news.newsmain?action=article&ARTICLE_ID=753757
- KPLU radio news story "Fish Plan," March 24, 2005, http://www.publicbroadcasting.net/kplu/news.newsmain?action=article&ARTICLE_ID=753758
- Vashon-Maury Island Beachcomber, "Draft Salmon Plan Discussion Set for Thursday at Land Trust," March 30, 2005
- City of Renton "Neighborhood News" e-notice, April 4, 2005
- South King Housing Issues E-newsletter, April 15, 2005

Display Advertising

Display advertisements announcing the public review period, public meetings, and web comment form were run in the following local newspapers:

- Auburn Reporter, March 9, 2005
- Kent Reporter, March 16, 2005
- Renton Reporter, March 16, 2005
- King County Journal, March 16, 2005
- Highline Times/Des Moines News, March 16, 2005
- West Seattle Herald/White Center News, March 16, 2005
- Federal Way News, March 16, 2005
- Enumclaw Courier-Herald, March 16, 2005
- Magnolia Herald, March 16, 2005
- Seattle Times, March 16, 2005
- Seattle Post-Intelligencer, March 16, 2005
- Vashon-Maury Island Beachcomber, March 23, 2005

Cable Television Readerboard Announcements

Readerboard announcements were requested of all the cities with cable television channels. Broadcast was confirmed by the Cities of Federal Way and SeaTac. Broadcast by other cities and Puget Sound Access (Channel 77) is unknown.

Web Presence

All outreach events and opportunities were regularly posted on WRIA 9 web page: http://dnr.metrokc.gov/Wrias/9/index.htm (as of January 2005, the WRIA 9 web site was ranked #2 out of 1.3 million on Google when searching for "salmon habitat")

The following jurisdictions placed links to the Draft Habitat Plan on their home pages or elsewhere on their websites during February – April 2005

- Auburn
- Burien
- Covington
- Des Moines
- Enumclaw
- King County (multiple locations)
- Renton
- Tukwila

The website also includes nearly all of the scientific materials and planning documents generated during the development of the Habitat Plan in 2002-2005.

City Council and Other Briefings

- Burien, March 7, 2005 (televised on City cable channel)
- King County Agriculture Commission, March 10, 2005
- Renton, March 14, 2005 (televised on City cable channel)
- Kent, March 15, 2005
- Covington, April 19, 2005

Public Open Houses and Meetings to Review the Draft Salmon Habitat Plan

- March 22, 2005 (Renton) -- topic: introduction to Draft Habitat Plan and public comment on it

- March 23, 2005 (Auburn) -- topic: introduction to Draft Habitat Plan and public comment on it

- March 31, 2005 (Vashon Island) -- topic: introduction to Draft Habitat Plan and public comment on it, with focus on marine nearshore issues

On-line Comment Form

To encourage people to comment who were not interested in or able to attend an open house/public meeting, an on-line questionnaire was posted March 10 – April 25, 2005. It was filled out on the Internet by 13 persons. No one complained about its length or any difficulties experienced in filling it out on-line. The questionnaire included responses where people could write out their comments on the Draft Habitat Plan.

5. Public Involvement Results and Use: 2004

Public input was sought on two major points:

- What actions do you think should be included in the Habitat Plan? (*Input on Developing Alternatives* from the Public Involvement Plan)
- What social/economic/political evaluation criteria – called "feasibility and effectiveness criteria" in the jargon of the plan – should be used to evaluate potential actions? (*Input on Social/Economic/Political Criteria* from the Public Involvement Plan)

The majority of the public comments were received between mid-September and the end of November 2004. This input was summarized. Available on-line (http://dnr.metrokc.gov/wrias/9/HabitatPlanPublicInput.htm#2004input) are:

- Spreadsheet listing all comments received at open houses/workshops and comments from the on-line survey
- Summary of web survey results

Public input was used in the fall of 2004 in two ways:

- Suggestions for possible actions (projects, programs, policies) were grouped by subwatershed and submitted to each of the subwatershed teams that developed draft recommendations in September-November 2004. (Suggested actions applicable watershed-wide were provided to all subwatershed groups.) These possible actions were "raw material" for the team members to consider as they created their list of actions. A number of these actions were subsequently developed and included in this draft Habitat Plan.
- Comments on the "feasibility and effectiveness criteria" received as of October 13 were presented to the Steering Committee on October 14 and informed their discussion and subsequent changes to the draft criteria. At the November 30 workshop, the public was asked to test the feasibility and effectiveness criteria on several sample actions. This test was subsequently repeated the following night with the Steering Committee itself. The

similar results affirmed the value of the criteria, which were subsequently used to review project and program-type actions before they were included in the Draft Habitat Plan.

6. Public Involvement Results and Use: 2005

Public input was sought on four major points, agreed to by the Steering Committee at its March 10, 2005 meeting:

- What projects, programs, and policies in the *draft* Habitat Plan do you most strongly **SUPPORT** and want included in the final Habitat Plan?
- What projects, programs, or policies in the *draft* Habitat Plan do you **DISAGREE** with? **WHY** do you disagree? How would you **CHANGE** the action to make it acceptable?
- What project, program, or policy would you **ADD** to the Habitat Plan? In other words, **WHAT IS MISSING** from the *draft* Habitat Plan?
- Do you have questions or comments about the **SCIENCE** underlying a project, program, or policy?

People were welcome to provide other questions, comments, or suggestions regarding the *draft* Habitat Plan in addition to responding to the questions above.

During the public review period March 10 – April 25, 2005, many comments were received from individual citizens, environmental groups, businesses, local governments, state and federal agencies, and individual Steering Committee members.

All comments – regardless of source – were organized by staff and posted on the watershed web site at: http://dnr.metrokc.gov/Wrias/9/HabitatPlanPublicInput.htm. Comments were organized so they would correspond to the relevant parts of the Draft Habitat Plan.

Comments were read by the subcommittees of the Steering Committee as they reviewed and revised the Draft Habitat Plan during April – June 2005. Steering Committee members read the relevant comments as they discussed revising specific parts of the Habitat Plan.

The Steering Committee made decisions about revising the Draft Habitat Plan in light of scientific facts, scientific uncertainty, fiscal constraints, legal requirements, and public input. Many public comments led the Steering Committee to make significant changes to the Habitat Plan, resulting in a final plan that is practical and effective.

D. PRIORITIZING CONSERVATION HYPOTHESES AND HABITAT MANAGEMENT STRATEGIES

Prioritization of conservation hypotheses developed in the functional linkages evaluation and the habitat management strategies is a key step in preparing to develop and evaluate actions for inclusion in the Habitat Plan.

Conservation Hypotheses

The 32 individual conservation hypotheses (CHs) are being prioritized based upon seven criteria, including Viable Salmonid Population (VSP) parameters and viability, salmonid life stages affected, magnitude of effect, necessary future conditions, certainty and factors of decline. This will result in priorities by subwatershed, watershed-wide ("all"), and non-habitat hypotheses. These priority CHs could then be further prioritized on a watershed-wide basis. Possible criteria for further prioritizing CHs at the watershed-wide level include contribution to overall Chinook viability, magnitude of effect, and certainty.

Subwatershed Habitat Management Strategies (HMS)

From the prioritization of the CHs, we can also prioritize the habitat conditions and/or processes in the subwatershed Habitat Management Strategies (HMSs). For instance, LG-1 (Protecting and creating/restoring habitat that provides refuge (particularly side channels, off channels, and tributary access) for juvenile salmon at a range of flow conditions) was identified as a high priority CH. This rating would translate into a high priority for three habitat conditions (channel geomorphology, tributary habitat and access, and water quantity) that support this CH. Further prioritization of the HMSs could occur at the habitat condition or strategy (protect, restore, rehabilitate, substitute) level. For instance, if the channel geomorphology condition moves us closest to implementation of LG-1, it would be a higher priority. Similarly, if restore and rehabilitate were key components of attaining the necessary channel geomorphology condition, they would also be identified as higher priorities.
Criteria for prioritizing strategies could include spatial applicability (e.g., subarea, RMs), temporal considerations (e.g., sequencing), and certainty of achieving habitat conditions.

Draft Criteria for Prioritizing Conservation Hypotheses

Does the CH address the VSP parameters identified as a priority for viability? (ratings: Low = neither P or SS; Med. = P or SS; High = both P and SS or all 4 VSP parameters)
What is the total number of salmonid life stages (egg, alevin, fry, fingerling/smolt, freshwater adult/spawner) directly affected by the CH? (ratings: 1, 2, 3, 4 or 5 life stages)
What is the potential magnitude of effect of the CH in leading to improved life stage productivity and overall viability? (ratings: Low, Med., or High magnitude of effect)
Does the CH address protection and/or restoration of process or processes that support and maintain habitat, habitat structure or habitat function? (ratings: Low = habitat function only; Med. = habitat structure and function; High = process)
Does the CH address specific habitat conditions identified in the Necessary Future Conditions analysis (ratings: Low = 1; Med. = 2, High = 3 or more conditions)

What is the certainty of the CH in achieving the desired habitat or improved VSP conditions? (ratings: Low, Med., or High certainty)
Does the CH address a factor of decline substantially limiting viability? (ratings: Low = factor of decline, but not necessarily limiting; Med. = factor of decline somewhat limiting viability; High = factor of decline substantially limiting viability)
Table D-1: Prioritization of Conservation Hypothesis By Watershed-Wide, Subwatershed And Non-Habitat Hypotheses (Scoring: H = 5, M/H = 4, M = 3, L/M = 2, L = 1, life stage = #)

Cons. Hyp.	VSP Parameters for viability	# of Life Stages	Magnitude of Effect	Process, Structure, Function	Habitat Conditions in NFC analysis	Certainty in Achieving	Factor of decline limiting viability	Overall Score
All-1	M	5	M	M/H	L	M	M	22
All-2	H	5	H	H	H	H	H	35
All-3	H	5	H	H	M	M	M/H	30
All-4	H	5	H	H	H	M/H	H	34
All-5	M	5	M	H	H	M/H	M	28
All-6	H	5	H	H	H	H	H	35
Near-1	M	2	M	M	L	L/M	L/M	16
Near-2	H	2	H	M	L	M/H	H	25
Near-3	M	2	H	H	H	M/H	M/H	28
Near-4	M	2	M	M	L	M	M	18
Near-5	H	2	M/H	M	L	M	M	21
Duw-1	H	3	H	M	H	H	H	31
Duw-2	M	3	M/H	M	L	M	M	20
Duw-3	H	3	H	M	H	H	H	31
Duw-4	H	3	M/H	M	M	H	M	26
Duw-5	H	3	H	H	M	M/H	H	30
Duw-6	M/H	3	M/H	M/H	L	M/H	M	23
LG-1	H	5	H	M	H	H	H	33
LG-2	H	5	M/H	M/H	H	M	M	29
LG-3	M	5	M	H	L	M	M	23
LG-4	H	5	L/M	M	L	L	L	18
MG-1	H	5	H	M	H	H	H	33
MG-2	M/H	5	M	H	H	M	M	28
MG-3	M	5	H	H	H	H	H	33
MG-4	H	5	H	M	H	M/H	M	30
MG-5	M	5	M	H	H	M/H	M	28
MG-6	M	5	M	N/A	L	M	M	18+
UG-1	M/H	5	H	N/A	L	H	H	25+
UG-2	H	5	H	M	H	M/H	M	30
UG-3	M/H	5	H	N/A	L	H	H	25+
UG-4	H	5	H	H	H	H	H	35
Non-Hab-1	M	1	H	N/A	M	M	M	18+

Non-Hab-2	M	3	H	N/A	M	M	M	20+
Non-Hab-3	M	2	L/M	N/A	N/A	L/M	L/M	11+

Priority Conservation Hypotheses (By Tiers) Considering The Seven Categories (34 Total)

Tier 1 (16 total)	Tier 2 (11 total)	Tier 3 (7 total)
All-2, All-4, All-6	All-1, All-3, All-5	---
Near-2, Near-3	Near-5	Near-1, Near-4
Duw-1, Duw-3, Duw-5	Duw-4, Duw-6	Duw-2
LG-1	LG-2	LG-3, LG-4
MG-1, MG-3, MG-4	MG-2, MG-5	MG-6
UG-1, UG-4	UG-2, UG-3	---
NH-1, NH-2	---	NH-3

E. SUMMARY OF TIERED CONSERVATION HYPOTHESES

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
Tier 1							
All-2	Protecting and improving riparian conditions by adding native riparian vegetation will enhance habitat quality by improving water quality, stabilizing streambanks, providing overhanging vegetation and large woody debris (LWD), and contributing organic matter, nutrients, and terrestrial prey items, thereby leading to greater juvenile salmon growth and higher survival.	All-1	Juvenile foraging/ rearing Juvenile migration Adult holding Adult spawning	Increase food availability Improve predator refuge Expand physiological refugia Expand high energy/flow refugia Enhance migration corridor Enhance rearing habitat Improve spawning ground quality for salmonids as well as forage fish in nearshore areas Pollution abatement Soil stability Erosion control Wildlife habitat Organic/nutrient inputs LWD inputs/habitat structure Microclimate Prey production	Abundance Productivity	Improved riparian conditions will enhance prey availability LWD recruitment will enhance pool and spawning habitat Enhanced prey availability will enhance growth and survival Juvenile salmon will use shade of improved riparian corridor and eventually LWD provided from riparian vegetation will provide refuge from fish and bird predators Forage fish egg survival is higher on shaded beaches Salmon utilization of tributaries will increase with improved conditions	Restore/ Moderate Rehabilitate/ Low-Moderate

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
All-4	Allowing natural flows (including low flows and habitat-forming flows) in a relatively unconstrained river channel will enhance habitat diversity and provide habitats that can support spawning and rearing salmon at a greater variety of flow conditions, thereby leading to expanded salmon spatial distribution, greater juvenile salmon growth, and higher survival. [Note: Less applicable to marine nearshore]	All-1 All-3 Low-1 Mid-1 Mid-5	Egg incubation Juvenile freshwater rearing Adult holding Adult spawning	Improve egg-to-fry survival Enhance rearing habitat Expand spawning ground availability Improve spawning ground quality Enhance rearing habitat	Abundance Productivity Diversity Spatial Structure	Natural disturbance creates more diverse and complex habitat for salmon Habitat complexity enhances productivity and increases life history diversity Scour impacts on redds are excessive and limit egg-to-fry survival	Restore/ Moderate
All-6	Preventing new bank/shoreline armoring and fill and removing existing armoring, fill and other impediments (e.g., levees) will enhance habitat quality and quantity and lead to improved juvenile salmon survival, spatial distribution, and diversity.	Near-2 Near-3 Near-4	All lifestages	Increase prey production Increase refugia Provide high energy/flow refuge Enhance migration corridor Expand rearing habitat	Abundance Productivity Diversity Spatial Structure	Increased habitat area, complexity, and diversity would result in increased species abundance, productivity, and diversity	Preserve/ High Restore/ Moderate
Near-2	Protecting and increasing the availability of vegetated shallow nearshore and marsh habitats will enhance habitat quantity and quality and lead to greater juvenile salmon residence time, greater growth, and higher survival.	All-6	Juvenile foraging/ rearing Juvenile migration Juvenile predator avoidance	Increase food availability Improve predator refuge Enhance migration corridor Enhance rearing habitat	Abundance Productivity Spatial Structure Diversity	Restoration of shallow water habitats will increase the production of prey items consumed by juvenile salmon. Enhanced prey availability will enhance survival.	Restore/ Moderate
Near-3	Protecting and restoring nearshore sediment transport processes by reconnecting sediment sources and removing shoreline armoring that impacts sediment transport will lead to greater prey production, greater juvenile salmon growth and higher survival.	All-6	Adult/ subadult foraging Juvenile foraging/rearing	Increase food availability Enhance migration corridor Enhance rearing habitat Increase and enhance forage fish spawning habitat	Abundance Productivity	Restoration of nearshore processes will increase the production of prey items consumed by juvenile salmon. Enhanced prey availability will enhance survival.	Preserve/ High Restore/ Moderate

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
Duw-1	Expanding and enhancing the Duwamish estuary, particularly vegetated shallow subtidal and intertidal habitats and brackish marshes by restoring dredged, armored, and filled areas, will enhance habitat quantity and quality and lead to greater juvenile salmon residence time, greater growth, and higher survival.	Near-2 Duw-3	Early estuarine rearing of subyearling and yearling outmigrants	Increase food availability Improve predator refuge Enhance migration corridor Enhance rearing habitat Expand physiological transition zone	Abundance Productivity Diversity Spatial Structure	Improved estuarine habitat will increase residence time, growth, and survival Restoration of shallow water habitats will increase the production of prey items consumed by juvenile salmon. Enhanced prey availability will enhance survival.	Restore/ Moderate Rehabilitate/ Low-Moderate Substitute/ Low
Duw-3	Enlarging the Duwamish River estuarine transition zone habitat by expanding the shallow water and slow water areas will enhance habitat quantity and quality of this key Chinook salmon rearing area, leading to greater juvenile salmon residence time, greater growth, and higher survival.	Duw-1	Brackish water rearing of fry and fingerling life stages	Increase food availability Expand physiological transition zone Increase refugia Expand rearing habitat	Abundance Productivity Diversity	Fish will expand habitat use to areas that are newly available The limited extent of the salinity transition zone due to modifications of the Lower Duwamish River reduces salmon residence time and growth Improved estuarine habitat will increase residence time, growth, and survival	Restore/ Moderate Rehabilitate/ Low-Moderate Substitute/ Low

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
Duw-5	Protecting and restoring natural sediment process (supply-transport-delivery) will increase the quantity and quality of available juvenile salmon rearing habitat, including salmon prey production.	All-8 Near-3 Low-2 Mid-3 Up-4	Freshwater and estuarine rearing of juvenile salmon	Increase food availability Expand physiological refugia Expand and enhance shallow water refuge Enhance juvenile migration corridor from estuary to marine nearshore	Productivity Abundance Diversity Spatial structure	The Duwamish is lacking sediment quantity due to supply interruption at HHD, flow regulation and hydromodification of river and stream banks. Localized erosion of stream banks continues to occur but does not provide the natural quantity or size distribution which would occur naturally. The lack of supply coupled with regular maintenance dredging for ship navigation is resulting in a degrading estuary and reducing sand/mudflat habitat which is important for salmon rearing.	Preserve Substitute
Low-1	Protecting and creating/restoring habitat that provides refuge particularly side channels, off channels, and tributary access), habitat complexity (particularly pools) for juvenile salmon over a range of flow conditions and at a variety of locations (e.g., mainstem channel edge, river bends, and tributary mouths) will enhance habitat quality and quantity and lead to greater juvenile salmon residence time, greater growth, and higher survival.	All-3 All-6 Duw-4 Mid-1	Egg incubation Freshwater rearing Adult holding Adult spawning	Increase food availability Improve refugia from predators Expand physiological refugia Provide high flow refuge Enhance migration corridor Improve spawning ground quality	Abundance Productivity Diversity Spatial Structure	Loss of habitat that serves as refuge in the Lower Green River limits freshwater productivity, diversity and spatial structure Lack of refuge habitat in upper estuary causes salmon to migrate downstream prematurely, particularly during high flow events	Restore/ Moderate

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
Mid-1	Protecting and creating/restoring habitat that provides refugia (particularly side channels, off channels, and tributary access), habitat complexity (particularly pools) for salmon over a range of flow conditions and at a variety of locations (e.g., mainstem channel edge, river bends, and tributary mouths) will enhance habitat quality and quantity and lead to greater salmon residence time, greater growth, and higher survival.	All-3 All-6 Duw-4 Low 1	Egg incubation Freshwater rearing Adult holding Adult spawning	Increase food availability Improve predator refuge Expand physiological refugia Provide high energy/flow refuge Enhance migration corridor Improve spawning ground quality	Abundance Productivity Diversity Spatial Structure	Lack of refuge habitat in causes salmon to migrate downstream prematurely	Restore/ Moderate
Mid-3	Protecting and restoring natural sediment recruitment (particularly spawning gravels) by reconnecting sediment sources to the river will help maintain spawning, adult holding, and juvenile rearing habitat.	Low-2	All life stages	Expand rearing habitat availability Expand spawning ground availability Improve spawning ground quality	Abundance Productivity	Improved spawning habitat in the Lower Green River will increase spawning and increase egg-to-fry survival Natural sediment recruitment will improve access to tributaries	Restore/ Moderate Substitute / Low
Mid-4	Preserving and restoring spawning and rearing habitat in lower Newaukum and Soos Creeks will increase habitat quality and quantity, thereby increasing productivity and spatial structure of Green River Chinook salmon.	All-2 All-3 Mid-2	All life stages	Increase food availability Improve predation refuge Provide high energy/flow refuge Improve spawning ground quality	Abundance Productivity Diversity Spatial Structure	Improved habitat quality in tributaries will lead to increased fish use, extended rearing time in freshwater, and increased survival Newaukum and Soos creeks can provide quality habitat for wild salmon	Preserve/ High Restore/ Moderate

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
Up-1	Establishing/restoring Chinook salmon access above HHD by providing passage upstream (trap and haul) beyond HHD and the reservoir for natural origin Chinook and downstream passage for the progeny as well as first generation hatchery fry will increase habitat quantity and expand salmon spatial structure. (Alternate Hypothesis: Augmenting restoration of salmon populations above HHD by re-introducing spring Chinook from a neighboring river system (possibly White River) will expand Chinook distribution, diversity, and enhance abundance in the river.) (Alternate Hypothesis: Restoring salmon above HHD without the use of hatchery outplants or returning hatchery adults will recover Chinook without bypassing important evolutionary processes (i.e., the selection of the fittest adults for spawning, and juveniles for incubation). [Note: Final decisions on which fish to pass upstream are dependent upon NOAA Fisheries, USFWS, and the co-managers (WDFW and Muckleshoot Indian Tribe)]		All life stages	Expand rearing habitat Expand spawning habitat	Productivity Diversity Spatial Structure	Availability of expanded habitats will lead to expanded salmon distribution and life history diversity	Restore/ Moderate Substitute/ Moderate

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
Up-4	Protecting and restoring natural sediment recruitment process by reducing the amount of slides and road-borne sediment will enhance salmon migration, spawning success and juvenile rearing.	Near-3 Duw-5 Low-2 Mid-3	Adult spawning Adult migration Juvenile incubation Juvenile rearing Resident rearing	Improve egg survival Increase food availability Enhance rearing habitat Improve spawning ground quality and access	Productivity Spatial structure Abundance	Upper watershed sediment regime is being adversely affected by forest practices.	Preserve Restore
Non-Habitat-1	Employing live capture techniques to harvest hatchery salmon (marked) and release natural salmon will reduce mortality of naturally-produced salmon while providing the opportunity to harvest a greater percentage of hatchery fish and thereby reducing straying of hatchery fish to the spawning grounds. [Note: Ranking of this hypothesis is based on the presumption of a segregated stock]		Adult	Increase adult survival Reduce interbreeding	Abundance Productivity Diversity	The ability to keep fish alive and distinguish between hatchery and natural salmon will allow more natural fish to be released By limiting catch of natural salmon, higher percentage of hatchery population can be harvested Interbreeding has led to decreased productivity, abundance, and diversity of natural Chinook	N/A
Non-Habitat-2	Modifying hatchery practices (e.g., more natural rearing conditions, smaller releases, release timing and location, genetic management, etc.) and improving the attractiveness of hatcheries to returning hatchery adults will lead to reduced interactions between hatchery- and naturally-spawned Chinook salmon, and enhance production of naturally spawned Chinook.		Adults Fry Smolts	Reduced hatchery and wild fish interactions Increase spawning by natural origin adults	Abundance Productivity	Reducing difference between hatchery and natural salmon while also reducing spatial and temporal overlap will reduce negative interactions on wild fish survival	N/A
Tier 2							

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
All-1	Protecting and improving water quality (e.g., temperature, dissolved oxygen, turbidity, and chemical contamination conditions) by addressing point and nonpoint (specifically stormwater runoff and agricultural drainage) pollution sources will enhance habitat quality and lead to greater juvenile salmon growth, disease resistance, and survival. Improved water quality will also enhance survival of adult salmon, incubating salmon eggs, and salmon prey resources, such as forage fish.	All-2 Low-3	All lifestages	Improve egg survival (both salmon and forage fish) Increase food availability Expand physiological refugia Enhance resistance to disease Enhance migration corridor Enhance rearing habitat Improve adult homing and upriver migration survival Pollution abatement Soil stability Erosion control	Abundance Productivity	Degraded water quality reduces the production of prey items consumed by juvenile salmon. Enhanced prey availability will enhance growth and survival. Degraded water quality influences juvenile salmon fitness and disease resistance. Degraded water quality influences adult homing and upriver migration survival. Improved water quality will contribute to adults having more energy for gamete development, upriver migration, and spawning that will lead to higher egg incubation survival.	Rehabilitate/ Low-Moderate
All-3	Protecting and improving access to tributaries will increase the quantity of available habitat, particularly for juvenile Chinook and coho salmon, and lead to expanded salmon spatial distribution, greater juvenile salmon growth, and higher survival.	Low-4	All lifestages	Increase food availability Expand areas providing refuge from predators Provide high energy/flow refuge Enhance migration corridor Expand rearing habitat Expand spawning ground availability	Abundance Diversity Spatial Structure	Salmon utilization of tributaries will increase with improved access and habitat condition Increased utilization will lead to longer residence times and higher survival	Restore/ Moderate

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
All-5	Preserving and protecting against watershed and upland impacts by implementing Low Impact Development techniques, including minimizing impervious surfaces, will maintain habitat quality by helping maintain flow and reduce sedimentation, thereby leading to greater salmon survival.	All-1 All-2 Low-3 Mid-2 Mid-5	All lifestages	Maintain food availability Maintain physiological refuge Maintain migration corridor Maintain rearing habitat Maintain adult homing and upriver migration survival	Abundance Productivity	Degraded watershed conditions and functions reduce the quantity and quality of instream habitat Reduced quantity and quality of instream habitat reduces productivity and diversity of salmon	Restore/ Moderate Preserve/ High
Near-5	Protecting and enhancing pocket estuaries (i.e., small non-natal smaller estuaries, lagoons, and spits) and salmon-bearing and non-salmon bearing tributary mouths by maintaining/ restoring tributary mouths will increase quantity of key habitat and lead to greater juvenile salmon growth and survival.	All-3	Adult foraging (cutthroat, and possibly others) Prey production Juvenile transition Migration Juvenile foraging/ rearing	Increase food availability Maintain or expand physiological transition zone	Abundance Productivity Diversity Spatial Structure	Increasing spatial diversity of available habitats will support greater life history diversity Enhancing pocket estuaries will lead to increased growth and survival	Preserve/ High Restore/ Moderate
Duw-4	Protecting, creating, and restoring habitat that provides refugia (particularly side channels, off channels, and tributary access), habitat complexity (particularly pools) for juvenile salmon over a range of flow conditions and at a variety of locations (e.g., mainstem channel edge, river bends, and tributary mouths) will enhance habitat quality and quantity and lead to greater juvenile salmon residence time, greater growth, and higher survival.	All-3 All-6 Low-1	Freshwater and estuary rearing Adult holding	Increase food availability Improve predator refuge Expand physiological refugia Provide high flow refuge Enhance migration corridor Improve spawning ground quality	Abundance Productivity Diversity Spatial Structure	Lack of refuge habitat in upper estuary causes salmon to migrate downstream prematurely	Restore/ Moderate

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
Duw-6	Protecting and improving water quality (e.g., temperature, dissolved oxygen, metals and organics) by addressing point and nonpoint (specifically stormwater runoff) pollution sources will enhance habitat quality and lead to greater juvenile salmon growth, disease resistance, and survival. Improved water quality will also enhance survival of adult salmon, and salmon prey resources.	All-1	Freshwater and estuary rearing Adult holding	Increase food availability Enhance resistance to disease Enhance migration corridor Enhance rearing habitat Improve adult homing and upriver migration survival Pollution abatement	Abundance Productivity	Degraded water quality reduces the production of prey items consumed by juvenile salmon. Enhanced prey availability will enhance growth and survival. Degraded water quality influences juvenile salmon fitness and disease resistance. Degraded water quality influences adult homing and upriver migration survival. Improved water quality will contribute to adults having more energy for gamete development, upriver migration, and spawning that will lead to higher egg incubation survival.	Rehabilitate/ Low-Moderate
Low-2	Restoring and enhancing sediment recruitment (particularly spawning gravels) by reconnecting sediment sources to the river will reduce channel downcutting, increase shallow habitats, improve access to tributaries, and improve spawning habitat, thereby leading to greater juvenile salmon residence time, greater growth, and higher survival.	Mid-3	Freshwater rearing Adult holding Adult spawning	Expand rearing habitat availability Expand spawning ground availability Improve spawning ground quality	Abundance Productivity Diversity Spatial Structure	Reduced sediment recruitment limits the availability of suitable spawning habitat Improved spawning habitat in the Lower Green River will increase spawning Natural sediment recruitment will improve access to tributaries	Restore/ Moderate Substitute/ Low

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
Mid-2	Protecting against watershed and upland impacts by implementing Low Impact Development techniques (see All-5) will be particularly beneficial in the sub-watersheds of tributaries that provide spawning (e.g., Newaukum and Soos Creeks) and/or rearing habitat (e.g., Jenkins and Covington Creeks) will increase habitat quality and quantity and promote utilization of non-mainstem habitats and prevent creating additional stressors that limit survival.	All-1 All-2 All-5 Mid-4 Mid-5	All lifestages	Maintain food availability Maintain physiological refuge Maintain migration corridor Maintain rearing habitat Improve adult homing and upriver migration survival	Abundance Productivity Diversity Spatial Structure	Degraded watershed conditions and functions reduce the quantity and quality of instream habitat Reduced quantity and quality of instream habitat reduces productivity and diversity of salmon	Preserve/ High
Mid-5	Maintaining regional groundwater recharge and base flows to the mainstem Green River through forest retention and Low Impact Development will maintain spawning and rearing habitat.	All-1 All-5 All-7 Low-3 Mid-2 Mid-4	All life stages	Increase food availability Maintain holding area quality	Abundance Productivity	Groundwater provides an important source of cold water which contributes to keep river temperatures lower Degraded watershed conditions and functions reduce the quantity and quality of instream habitat Reduced quantity and quality of instream habitat reduces productivity and diversity of salmon	Preserve/ High

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
Up-2	Protecting and restoring/enhancing habitat (e.g., side channels, pools) along the upper Green River mainstem and major tributaries (e.g., North Fork, Smay Creek) by restoring the riparian corridor will enhance habitat quality and lead to greater residence time and survival (after the establishment of populations above HHD]).	All-2 Up-1	Egg incubation Juvenile rearing Adult holding Adult spawning	Improve egg survival Increase food availability Enhance rearing habitat Improve spawning ground quality	Abundance Productivity Diversity Spatial Structure	Improved habitat in upper watershed will enhance fish survival and lead to extended residence times and increased survival Runs are re-established in upper watershed	Preserve/ High Restore/ Moderate
Up-3	Establish bull trout population above HHD by providing passage upstream (trap and haul) beyond HHD and the reservoir for returning adults and downstream passage for the progeny increase habitat quantity and expand spatial structure. Note: Final decisions on which fish to pass upstream are dependent upon NOAA Fisheries, USFWS, and the co-managers (WDFW and Muckleshoot Indian Tribe)		All life stages	Expand rearing habitat Expand spawning habitat	Diversity Spatial Structure	Upper watershed provides habitat to support bull trout	Restore/ Moderate
Tier 3							
Near-1	Protecting and improving sediment quality, particularly in Elliott Bay will enhance habitat quality and lead to greater juvenile salmon growth and higher survival.	All-1 Duw-2	Juvenile foraging/ rearing Juvenile migration	Increase food availability Enhance resistance to disease Increased growth	Abundance Productivity	Sediment quality reduces the production of prey items consumed by juvenile salmon. Enhanced prey availability will enhance survival.	Preserve/ High Restore/ Moderate Rehabilitate/Low-Moderate

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
Near-4	Protecting and expanding forage fish spawning areas by maintaining/ increasing high intertidal zone access and maintaining/ increasing availability of suitable substrate sizes will lead to greater juvenile salmon growth and higher survival.	All-6 Near-2 Near-3	Juvenile foraging/ rearing Adult foraging	Increase food availability Enhance rearing habitat	Abundance Productivity	Expanded forage fish spawning areas will lead to greater prey availability for juvenile and adult salmon. Enhanced availability of forage fish prey will enhance salmon survival	Preserve/ High Restore/ Moderate
Duw-2	Protecting and improving sediment quality will enhance habitat quality and lead to greater juvenile salmon growth, disease resistance, and higher survival.	All-1 Near-1	Early estuarine rearing of subyearling and yearling outmigrants Adult migration Adult holding	Increase food availability Enhance resistance to disease	Abundance Productivity	Sediment quality reduces that production of prey items consumed by juvenile salmon. Enhanced prey availability will enhance survival.	Rehabilitate /Low-Moderate
Low-3	Preserving and maintaining groundwater inflow from historical White River channel will contribute to maintaining river flows and good water quality, thereby leading to greater juvenile and adult salmon survival.	All-1	Freshwater rearing Adult holding	Maintain rearing habitat Enhance migration corridor	Abundance Productivity	Water quality downstream of the White River is limiting productivity White River groundwater continues to provide a significant inflow during low flow periods	Preserve/ High
Low-4	Modifying the Black River Pump Station to allow fish passage will increase habitat quantity and lead to greater juvenile salmon residence time and growth.	All-3	Freshwater rearing	Expand rearing habitat	Abundance Productivity Diversity Spatial Structure	Water quality and quantity is adequate to support juveniles	Restore/ Moderate
Mid-6	Restoring Chinook salmon access between the Tacoma Diversion Dam (TDD) and Howard Hanson Dam (HHD) by providing passage upstream and downstream at the TDD for natural origin Chinook will increase habitat quantity and expand spatial structure.	Up-1	All life stages	Expand rearing habitat Expand spawning habitat	Abundance Diversity Spatial Structure	Salmon will spawn in reach if allowed access	Restore/ Moderate

ID	Draft Conservation Hypothesis	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Habitat Management Strategy Type/Relative Certainty
Non-Habitat -3	Reducing harvest of nonsalmonid commercially and recreationally important species (e.g., Dungeness crab, and forage fish) will lead to greater prey availability for juvenile and adult salmonids		Adult foraging Juvenile foraging	Foraging	Abundance Productivity	Forage fish are a primary component of Chinook diets as they get larger than 150mm. Reducing direct harvest of a prey item will increase its availability to Chinook and increase growth and survival	N/A

Note: 1) Strategy type and degree of certainty as defined in the "Integrated Recovery Planning for Listed Salmon: Technical Guidance for Watershed Groups in Puget Sound" by the Puget Sound Technical Recovery Team and Shared Strategy Staff Group (Draft February 3, 2003). Relative certainty was presented based on an increasing uncertainty of success in achieving VSP parameters in order of the strategy types from protect (least uncertainty), restore, rehabilitate, to substitute (most uncertainty).
Yellow highlight denotes references cited by Technical Committee without a full citation provided.

F. RELATIONSHIPS BETWEEN HABITAT MANAGEMENT STRATEGIES AND CONSERVATION HYPOTHESES

(See separate 11x17 file)

G. PROJECTS FOR FUTURE CONSIDERATION

The purpose of this appendix is to list projects for further consideration during the second ten years of the Habitat Plan (2016-2025). Although the projects described in chapter five of the Habitat Plan are priorities for implementation during the first ten year of the plan, projects in appendix G could be considered for implementation during 2006-2015 if opportunities to conduct them arise and would be lost if not acted on. It is expected that adaptive management will provide information that allows a re-evaluation of potential projects listed in this Appendix.

Upper Green River Subwatershed

ID#	Name and Location
UG3	North Fork Green River tributary improvements (El. 1147-1777)
UG4	Protecting/improving riparian conditions in the North Fork Green River (El. 1177 to 1240)
UG5	Protecting/improving riparian conditions in the North Fork Green River (El. 1240 to 1320)
UG6	Page Mill Pond and Creek habitat restoration (spring-fed tributary to the North Fork Green River)
UG7	Piling Creek riparian and instream improvement (near mouth of North Fork Green River)
UG8	Charley Creek riparian and instream improvement (near mouth of North Fork Green River)
UG9	Cottonwood Creek riparian and instream improvement (near mouth of North Fork Green River
UG9a	Temperature Total Maximum Daily Load water quality restoration plan projects in areas on the 303(d) list
UG10	Gale Creek tributary improvements (El. 1147 to 1777)
UG11	Large woody debris placement (RM 68)
UG12	Upper reservoir sub-impoundment project (West of railroad crossing of Green River and south of access road #5500)
UG13	Riparian and instream improvement to Phase I and II pool raise zone (RM 69.5–71.0, at confluence with Howard Hanson Reservoir)
UG14	Riparian and instream improvement to Phase I and II pool raise zone (RM 71-73)
UG15	"Welchers" large woody debris placement (RM 73 to 73.8)
UG17	Large woody debris placement (RM 75)
UG18	"Champion Creek" large woody debris placement (RM 78)
UG19	“Hot Springs" large woody debris placement (RM 79)
UG20	"6 mile" large woody debris Placement (RM 80 to 80.7)
UG21	Standing timber retention within reservoir inundation zone (~RM67)
UG22	Sedge planting within reservoir inundation zone (~RM67)
UG23	Protect/revegetate RM 68 to 74
UG24	Riparian improvements (RM 77.8 to 79.6 LB (including RM 79 +/- (Hot Springs field))
UG25	“Air strip” riparian improvements (RM 83 to 84)
UG26	Riparian vegetation restoration (RM 84.2 to 86)
UG27	“Power corridor” riparian improvements (2.75 miles upstream of the Sunday Creek confluence)
UG28	Rehabilitation of timber stands (RM87 to 88)
UG31	Olsen Creek culvert replacement (~RM 74)
UG32	Gold Creek culvert replacement (near RM 75)
UG33	May Creek culvert replacement (between RM 74 and 75)
UG34	Maywood Creek culvert replacement (near RM 75)

ID#	Name and Location
UG36	Green Canyon Creek culvert replacement (intersection of Green Canyon Creek and road 5500 (~RM79))
UG37	"Airfield" large woody debris placement (RM 83.8)
UG38	Northeast Creek fish culvert replacement (up from RM 84 and halfway up East Creek)
UG39	Intake Creek culvert replacement (Intake Creek (up from ~RM 86))
UG41	Strategy to protect habitat quality (RM 75.5 to 77)
UG47	Relocation of 90-degree "dog leg" (+/-RM 81)
UG48	Restoration of mainstem channel alignment (RM 87)
UG51	Protection of off-channel habitat (RM 84)
UG52	Protection of off-channel habitat (RM 84.1 to 85)
UG53	Protect cool, clean sources of water in the North Fork Green River
UG54	Protect cool, clean sources of water from RM 84.1-93.6
UGxx	Engineered log jams at RM 70-71; +/- RM79
UGY	Fish carcass “nutrient” supplementation (above Howard Hanson Dam)

Middle Green River Subwatershed

ID#	Name and Location
MG9	MG9 Sinani Slough Not rated because project is completed
MG15	Lake Meridian Outlet
MG16	Meridian Valley Creek Relocation
MG17	Middle Green River LWD
MG18	MG18 Tacoma Diversion Dam (TDD) log jams Not rated because project is completed
MG23	TTD downstream passage
MG24	Howard Hansen Dam Trap and Haul
MG25	Cosgrove Property Riparian Planting
MG26	Ewing Property Riparian Planting
MG27	White Property Riparian Planting
MGA3	Middle Green Blueprint – floodplain reconnection, revetment removal/setback, meander logjam, gravel addition, invasive plant control, and riparian revegetation
MGB1	Middle Green Blueprint – revetment setback, floodplain reconnection, logjam addition, Japanese knotweed removal, gravel addition, and riparian revegetation
MGB2	Setback of levees to reconnect floodplain and allow channel migration near RM 41.
MGB2T	Middle Green Blueprint – Crisp Creek enhancement, Crisp Creek tributary enhancement
MGC1	Middle Green Blueprint – logjam addition, Japanese knotweed removal, riparian revegetation, O'Grady terrace reforestation, and channel migration zone buyout
MGC1T	Middle Green Blueprint – Burns Creek restoration
MGD1	Middle Green Blueprint – Loans and Turley levees setback, Burns Creek mouth, logjam/wood addition, Japanese knotweed removal, and riparian revegetation
MGD2T	Middle Green Blueprint – Tributary 09.0098 (conservation easement, fencing, revegetation)
MGE1	Middle Green Blueprint – Auburn Narrows side channel-Phase 2, Mueller revetment setback, logjam/wood addition, Japanese knotweed removal, and riparian revegetation
MGE1T	Middle Green Blueprint – Soos Creek confluence (lower mile)
No #	Brown Floodplain Restoration Project. (Newaukum Creek RM 7.3)
No #	Johnson Floodplain Restoration Project. (Newaukum Creek RM 7.4)
No #	LDS Floodplain and Wetland Restoration Project Newaukum Creek RM 6.5 – 7)

ID#	Name and Location
No #	Newaukum Creek Project 2 (Newaukum Creek RM 4 to 6)
No #	Protect and restore areas being surplused by the Washington Department of Natural Resources: 1) 78 acres in 3 parcels adjacent to and south of the Green River Natural Area, 2) 38 acres southwest of Bass Lake

Lower Green River Subwatershed

ID#	Name and Location
LG1	Foster Golf Course to Fort Dent Bridge conifer underplanting (RM 10.80-11; RM 11.3-11.8)
LG2	Maule Avenue acquisition and off-channel habitat rehabilitation
LG4	Office Park conifer underplanting (RM 11.7-12.4)
LG5	Family Fun Center: Revegetation
LG6	SR-405 Interurban Avenue Interchange riparian reforestation (RM 12.4-12.6)
LG7	Road ROW abandonment and revetment setback
LG9	68th Avenue South flap gate retrofit
LG10	Best Western revetment setback; LWD
LG11	Lower West Valley Highway Meander Bend revetment setback and excavation off-channel habitat
LG12	Upper Christensen Road-Strander Bridge revegetation and conifer underplanting (RM 12.6-13.25)
LG13	Levee floodwall setback (RM 13 to 13.2 and 13.95 to 14.3)
LG14	RR Bridge bench area reforestation (RM13.5)
LG15	Marriott Residence Inn conifer underplanting (RM 13.20-13.5)
LG16	Upper West Valley Highway meander bend acquisition: Revetment setback and off-channel habitat rehabilitation
LG17	NC Machinery ROW Acquisition and riparian habitat rehabilitation
LG18	Minkler Avenue forebay underplanting (RM 13.9)
LG19	Upper West Valley Highway meander bend revegetation (RM 13.8-13.9)
LG20	Pump Plan bench reforestation (RM13.9-14.15)
LG21	Christianson ROW acquisition, levee setback, and habitat rehabilitation
LG22	Segale parking lot ROW acquisition, levee setback, and habitat rehabilitation
LG24	Upstream end of Desimone Levee ROW Acquisition, levee setback and habitat rehabilitation
LG25	Upstream end of Segale Levee setback and habitat rehabilitation
LG28	Angle Lake Outlet fish passage restoration
LG29	Downstream end of Christian Brothers revetment setback and habitat restoration
LG32	S. 228th Street off-channel swamp acquisition and habitat rehabilitation (RM 17.10-21.30)
LG33	Orillia Acquisition, fish passage blockage removal, and off-channel habitat rehabilitation
LG34	South 228th Street off-channel swamp acquisition and habitat rehabilitation
LG36	Kent Golf Course: Narita/Myers levee setback
LG37	Keng Golf Course: Frager Road revetment setback
LG39	Upper Frager Road Acquisition: Revetment setback and habitat restoration
LG40	Hawley Road floodplain wetland and off-channel habitat rehabilitation
LG42	Kent Airport: Acquisition, levee setback, and habitat rehabilitation
LG43	Milwaukee acquisition: Levee setback and off-channel habitat rehabilitation
LG44	259th Street acquisition: Levee setback and habitat rehabilitation
LG46	Breda Levee setback and habitat rehabilitation

ID#	Name and Location
LG47	Central Avenue acquisition: Floodplain habitat rehabilitation and off-channel refuge
LG53	Green Valley Road revetment setback
LG54	Cooter Pond fish passage restoration and off-channel habitat rehabilitation
LG55	Reddington Levee: Fish passage restoration and off-channel habitat rehabilitation
LG56	Dykstra Park Levee setback and habitat rehabilitation
LG57	Valentine Revetment setback and habitat rehabilitation
LG58	Dykstra/Riverside/Galli Levee: Setback and habitat rehabilitation
LG59	S. 104th Street revetment setback and habitat rehabilitation (RM 30.10-30.50)
LG60	"Pig Farm" floodplain wetland rehabilitation
LG61	Mueller Levee removal, Phase 2 (RM 32.2-32.6)
LGD	Upper Springbrook Creek (S. 55th Street to SR 167)
LGE	Mill Creek East
LGF	Garrison Creek (4 sites)
LGH	Merlino Reach
LGI	Wetland 5K Reach (Mill Creek, north of Goedeke reach)
LGJ	Goedeke North Reach (Mill Creek at Highway 8 to Main Street in Auburn)
LGL	Meridian Valley Creek
LGM	Lake Meridian Outlet
LGP	West Hill Springs channel improvement (completed)
LGQ	Green River Natural Resource Area enhancement project (RM18.25-19.3)
LGR	Port of Seattle wetland mitigation

Duwamish Estuary Subwatershed

ID#	Name and Location
DUW1	Protect areas with relatively healthy vegetation
DUW2	Trail setback and revegetation (RM 10.7 to 11.1)
DUW3	Revegetation of understory at Foster Golf Course (RM10.8 to 11.5)
DUW4	Side channel construction (RM 10.6 to 10.7)
DUW5	Revetment setback at Foster Golf Course (RM 9.85 to 10.1 and 10.45 to 10.6)
DUW7	Riparian revegetation (RM 9.0 to 9.1)
DUW9	Revetment setback; LWD; revegetate (RM 8.7 to 8.9)
DUW10	Noxious weed control (RM 8.3)
DUW11	Codiga Farm Restoration Project and bank retrofit
DUW13	125th Street revetment setback
DUW14	Revegetation at Link light rail crossing (RM 8)
DUW15	Revegetation (RM 7.3 to 8.0)
DUW19	Gateway North revegetation; LWD (RM 6.55 to 6.85)
DUW20	Revetment setback; LWD; revegetate (RM 6.55 to 6.85)
DUW21	Cecil Moses Park sill retrofit
DUW22	Rubber Tire Bank rehabilitation
DUW28	Hamm Creek daylighting
DUW31	Derelict vessel removal
DUW33	Duwamish Waterway Park

ID#	Name and Location
DUW34	Georgetown Pump Station
DUW35	Soften armoring RM 2.0 to 5.5
DUW36	1st Ave. South bank layback
DUW38	Puget Creek Protection
DUW39	Puget Creek mouth daylighting
DUW40	Revegetation at Terminal
DUW41	Spokane St. Bridge shallow water habitat
DUW42	Longfellow Creek mouth daylighting
DUW43	T-108/LaFarge bank restoration
DUW45	Riverton Creek Upper Basin Restoration
DUW46	Southgate Creek Restoration Phase II
DUW47	Southgate Creek Restoration Phase III daylighting
DUW48	Southgate Creek Restoration Phase IV
Duw49	City Light South: excavate shallow water habitat

Marine Nearshore Subwatershed

ID#	Name and Location
Marine Nearshore Project Starter List for Program N-1 (Section 7.4)	
47	Remove 12 creosote piles immediately west of the Vashon Ferry Terminal
48	Remove 16 creosote piles west of Vashon Ferry Terminal
58	Remove 8 creosote piles between Scales Corner and Glenn Acres.
59	Remove 9 creosote piles just north of Glenn Acres
63	Remove 6 creosote piles at Glenn Acres
68	Remove 12 creosote piles from lower subtidal just north of Vashon Landing
69	Remove concrete piles just south of Vashon Landing
72	Remove 5 creosote piles just downstream of the outlet to Point Heyer Marsh.
73	Remove 16 creosote piles between Point Heyer and Ellisport Creek.
79	Remove 5 creosote piles in Tramp Harbor along Dockton Rd SW.
80	Remove 6 creosote piles ½ mile East of Portage along Maury Island
90	Remove ~10 creosote piles between Gold Beach and Glacier Gravel Mine.
97	Remove 2 creosote piles at Dockton Head.
102	Remove 12 creosote piles from lower intertidal – subtidal 1000 ft west of the county dock at Dockton.
104	Remove 2 creosote piles just north of Dockton Park.
107	Remove 2 creosote piles 1500 feet southwest of the mouth of Mileta Creek.
109	Remove 2 creosote piles just south of Portage within Quartermaster Harbor.
113	Remove 10 creosote piles near SW Quartermaster DR just west of unnamed creek/marsh
121	Remove 9 creosote piles, approximately 800 feet north of Quartermaster Yacht Club.
122	Remove 6 creosote piles on the north side of the neck of the Burton Peninsula.
123	Remove 3 creosote piles on the northern side of Burton Peninsula, just waterward of 99 Ave. SW
124	Remove 3 creosote piles on the northern side of Burton Peninsula, near 95th PL SW.
125	Remove 16 creosote piles from intertidal, just east of the Burton Public Boat ramp.
127	Remove 2 creosote piles near the mouth of Fisher Creek.
129	Remove 10 creosote piles and rubble from intertidal between Fisher and Shawnee Creeks
130	Remove 12 creosote piles approximately 1,500 feet south of Lost Lake Park.
132	Remove 4 creosote piles, approximately 1,000 feet West of Neill Point.
133	Remove 15 creosote piles, approximately 2,000 feet East of the Tahlequah Ferry Landing.
134	Remove 2 creosote piles just east of the Tahlequah Ferry Landing.
136	Remove 15 creosote piles adjacent to dock at Spring Beach
137	Remove 12 creosote piles waterward of dock at Spring Beach
139	Remove 18 creosote piles just north of Camp Sealth
148	Remove 2 creosote piles at Lisabeula Park
156	Remove 16 creosote piles in subtidal area near Cove.
157	Remove 16 creosote piles in intertidal area near Cove.

ID#	Name and Location
160	Remove 3 creosote piles ~800 feet north of Cove.
161	Remove 12 creosote piles just south of point “light” on USGS maps.
163	Remove 15 creosote piles and dock just north of point “light” on USGS maps.
169	Remove 3 creosote piles between point “light” and Peter Point.
28	Remove 30 creosote piles along shore at the Perkins lane slide.
31	Remove 20 creosote piles near sewer outfall south of Perkins Lane slide
32	Remove 20 creosote piles near Seacrest Marina.
82	Remove 30 creosote piles East of Fern Heath
87	Remove 32 creosote piles at the Southwest end of Gold Beach.
88	Remove 20 creosote piles west end of Gold Beach
93/94	Remove relict piles east of Rosehilla.
92	Remove 26 creosote piles and pier remnants at Sandy Shores
105	Remove 20 creosote piles at the mouth of South Dockton Creek
106	Remove 25 creosote piles just north of the mouth of North Dockton Creek.
110	Remove relict wharf piles at Portage inside Quartermaster Harbor.
119	Remove 25 creosote piles in Judd Creek estuary just downstream of old barge.
138	Remove 35 creosote piles at the North side of Camp Sealth
153	Remove 12 creosote piles and derelict pier between Robinwood Creek and Garden Creeks
174	Remove 5 creosote pilings and relict dock just south of Sylvan Beach
67	Remove approximately 100 creosote piles from lower intertidal between Beal Creek and Gorsuch Creek
74	Remove 5 dolphins, 80 creosote piles, concrete rubble at the mouth of Ellisport Creek.
85	Remove creosote piles and failed pier just East of Gold Beach
86	Remove 50 creosote piles at Gold Beach
98	Remove 50+ creosote piles in intertidal between Dockton Head and Dockton Boat ramp.
103	Remove 70 creosote piles just west of Dockton boat ramp
135	Remove derelict pier and 50 creosote piles west of Tahlequah ferry terminal
176	Remove 70 creosote piles at Sylvan Beach
29	Remove 35 creosote piles and boulders from intertidal, just East of the Perkins Lane slide.
55	Remove 8 creosote piles and two relict structures about 500 feet north of Aquarium site.
51	Remove 20 piles and riprap extending into intertidal at Cowley
118	Remove 4 concrete structures and 10 creosote piles in intertidal at Judd Creek Estuary.
172	Remove 3 creosote piles and intertidal rockery from about 1000ft south of Sylvan Beach
35	Remove creosote piles and consider removing groins 2000 feet northwest of the mouth of Miller Creek
37	Remove 15 creosote piles and consider removing groins about 3000 feet south of the mouth of Miller Creek Estuary
46	Remove 30 creosote piles and failed creosote bulkhead about 750 feet West of Vashon Ferry Landing
49	Remove creosote piles and failed bulkhead 1000 feet West of Dolphin Point
56	Remove 2 creosote piles and failed bulkhead just North of the Aquarium Site.
64	Remove 10 creosote piles and failed bulkhead 2000 feet North of Point Beals
65	Remove 20 creosote piles and failed bulkhead 2000 feet South of Point Beals.
99	Remove creosote pilings, failed bulkhead, derelict house in intertidal just East of Dockton Head.
151-152	Remove 8 creosote piles and bulkhead 2000 feet south of Robinwood Creek.
154	Remove 12 piles and bulkhead remnants at point “tide” as labeled on USGS maps.
155	Remove 8 creosote piles and bulkhead remnants 1200 feet North of point “tide” as labeled on USGS maps.
179	Remove failed bulkhead and 4 creosote pilings 2300 feet south of Point Vashon.
53	Remove 11 creosote piles and failed bulkhead—land sliding occurring behind bulkhead at Cowley
54	Remove 16 creosote piles and bulkhead in intertidal, 1000 feet north of Aquarium site.
84	Remove creosote piles (dolphins) from subtidal, revegetate riparian and bank crest area at Maury Island Marine Park.
91	Remove creosote piles, dolphins and pier; re-vegetate marine riparian at Glacier Gravel Mine (Pier replacement in process of permitting. Undertake this project if replacement does not take place)
25	Purchase property; remove abandoned cabin, bulkhead and associated debris, just North of Perkins Lane Slide.
26	Remove failed bulkhead, pieces of the houses, bathtub and riprap at Perkins Lane Slide
30	Remove relict bulkhead and debris forming groin from intertidal East of Perkins Lane Slide
34	Remove creosote bulkhead at Brace Point
39	Remove failed bulkhead just North of Des Moines Creek remove rock and debris from beach
41	Remove failed bulkhead near the Masonic Home of Washington

ID#	Name and Location
42	Remove failed bulkhead, 2000 feet South of the mouth of McSorely Creek.
43	Remove failed bulkhead, 2200 feet South of the mouth of McSorely Creek.
44	Remove bulkhead, 2400 feet South of the mouth of McSorely Creek.
45	Remove bulkhead, 5000 feet West of the mouth of Lakota Creek.
50	Bulkhead removal at NE Vashon Park
57	Creosote bulkhead removal at Aquarium site
61	Remove creosote and concrete bulkhead from intertidal 800 feet North of Glen Acres Creek mouth
62	Remove failed concrete bulkhead and groins 500 feet North of Glen Acres Creek mouth
112	Remove several small rock groins and protruding bulkhead with fill about 2000 feet East of the mouth of Tsugwalla Creek.
117	Remove concrete debris and failing bulkhead about 700 feet West of the mouth of Tsugwalla Creek
141	Remove bulkhead materials (creosote wood) from backshore, 600 feet North of Shipwreck point.
142-143	Remove concrete and timber bulkhead, 800 feet North of Shipwreck point.
144-145	Remove telephone poles, creosote, bulkhead; about 1000 feet North of Shipwreck Point.
146-147	Remove failed bulkhead and creosote piles, 2000 feet southwest of the mouth of Christensen Creek
149-150	Remove riprap/bulkhead, 400 feet South of “Stump” point.
162	Remove concrete rubble wall, 600 feet South of “light” point.
178	Remove remnants of failed bulkhead, 1500 feet North of Sylvan Beach
183	Purchase 2 vacant parcels and remove bulkhead, North of Des Moines Beach.
184	Remove 500 feet of gabion wall in tramp harbor in the upper intertidal zone adjacent to the mouth of Ellisport Creek.
111	Enhance mini-estuary, remove 14 creosote piles and associated fencing and other debris, eradicate invasive species at small unnamed creek mouth 2000 feet East from the mouth of Tsugwalla Creek
126	Remove creosote logs from marsh at SE point of Burton Peninsula.
27	Remove lumber and associated anthropogenic debris derived from slide including riprap at the Southern end of the Perkins Lane slide.
52	Remove extensive riprap over intertidal, about 1000 feet South of NE Vashon Park.
75	Remove creosote bulkhead, fill and rockery over intertidal, just North of Public Fishing Dock in Tramp Harbor.
77	Remove fill and creosote bulkhead, just South of Public Fishing dock in Tramp Harbor.
81	Remove downed shed on backshore, about 2500 feet West of Fern Heath.
89	Remove large concrete block/footing, 1500 feet Northeast of the Glacier dock.
96	Remove creosote LWD across intertidal just South of Dockton head.
100	Remove creosote dock/barge East of Dockton Head.
114	Remove concrete rubble, 1200 feet East of the mouth of Tsugwalla Creek.
115	Remove creosote log secured to beach just West of the mouth of Tsugwalla Creek.
120	Remove derelict barge/cannery at the mouth of Judd Creek.
128	Remove creosote wood collection serving as “home-made” bulkhead, 700 feet South of the mouth of Fisher Creek
131	Remove ecology blocks from intertidal, just Southwest of Neill Point.
140	Remove house remnants in backshore, just North of Shipwreck Point
164-165	Remove boulders from older rock wall off of the intertidal, just East of Point “light” on USGS maps.
167	Remove dock stored on intertidal, just Northwest of the mouth of Skeeter Creek
171	Remove steel structure from intertidal zone just West of Fern Cove.
173	Remove creosote pier and derelict structures, 750 feet South of Sandy Beach.
185	Retrofit Stormwater Pipe-put underground and remove intertidal fill—(.2 acres of fill) just west of the marina.
71	Eradicate invasive species (Rubus discolor, Cytisus scoparius, and phragmites) from marsh at Point Heyer
170	Eradicate invasive species (Cytisus scoparius) from marsh at Peter Point
60	Remove creosote wood groin, 1700 feet North of Glen Acres.
70	Remove concrete groins, at Klahanie.
83	Remove rock groins, 2000 feet West of Luana Beach
95	Remove wood groin at “Low”
175	Remove groin field, just South of Sandy Shores derelict pier.
177	Remove remnants of 6 wooden groins, just north of Sandy Shores derelict pier.

ID#	Name and Location
NS17	Salmon Creek Dam removal and culvert replacement.
NS20	Jetty Removal in Normandy Park
NS30	Remove failing bulkhead at Collier property on Maury Island
NS32	Remove invasive vegetation and plant native species in the marine riparian zone at Maury Island Marine Park.
15A	Remove 14 piles at near the end of 51st Ave SW in Federal Way.
8a	Remove 20 creosote piles from intertidal just West of Dumas Bay Park.
17A	Remove approximately 50 creosote piles and failed creosote soldier pile bulkhead 300 feet West of Dash Point State Park
10A	Remove decaying barge and 2 creosote dolphins from the intertidal zone near the Palisades Retreat Center
1A	Remove fill, bulkhead and pavement over intertidal zone about 2,200 feet Northeast of the mouth of Lakota Creek.
11A	Remove creosote soldier pile bulkhead from intertidal zone in front of the Palisades Retreat Center.
2A	Remove concrete footings of relict boat ramp about 1,800 feet Northeast of the mouth of Lakota Creek.
4A	Remove concrete rubble in the intertidal zone and upper beach, 300 feet North of the mouth of Lakota Creek
6A	Remove creosote logs and 12 piles on beach east of stream mouth/wetland complex at Dumas Bay Park.
9A	Remove heavily creosoted dolphin that is on shore, just West of Dumas Bay Park.
12A/ 13A/ 14A	Remove buried tires in intertidal zone (appears to be some form of shoreline armoring) West of the Palisades Retreat Center.
Others	
NS1	Protect feeder bluffs along 0.75 mile shoreline of south Discovery Park and adjacent area to south by purchasing them.
NS11	Fairmont Creek restoration
NS14	Schmitz Creek restoration
NS16	Relocate WSF Fauntleroy Dock offshore and install a shoreline beach. This would open up migration corridor, increase the amount of shallow water area, and allow sediment and wood longshore transport.
NS19	Protect waterward side of Three Tree Point Road. Area is currently in City of Burien right-of-way; however, potential legal action may be forthcoming to make it private property
NS23	Dumas Bay restoration via removal of 700 ft of shoreline armoring in Dumas Bay, reconnection of sediment supply to aquatic areas, and planting of riparian vegetation
NS35	Create rearing habitat with LWD in lower mainstem of Shinglemill Creek
NS39	Restore 6.27 acres of property in key nearshore zone at Eagle Landing and provide interpretive signs for education.
NS41	Beall Creek Fish Passage Improvement; Rehabilitate or replace diversion structure to allow fish passage as well as water withdrawal
NS42	Brown Acquisition. Acquire 9.11 acre parcel adjoining Seahurst Park; parcel contains artesian headwaters of salmon bearing stream.
NS45	Walker Creek Water Right and Land Acquisition
NS46	Piner Point acquisition. Acquire 5 properties totaling 6 acres encompassing Piner Point on Maury Island
NS47	Walker Creek Wetland Acquisition. Acquire key property that include headwaters of Walker Creek, a

ID#	Name and Location
	salmon bearing steam
NS48	Salmon Creek By-pass Line/outfall modification. Restore storm water and peak flow water quality and quantity
NS49	Treat Lake Hicks with alum for invasive aquatic weeds – must be repeated every 3 years
NS50	Acquire key parcels on Mallard Lake
NS51	Mallard Lake Wetland Water Quality Treatment
NS52	Provide native plantings and fecal coliform level signage on Mallard Lake
NS53	Improve water quality in Salmon Creek by utilizing existing undersized detention facility at $108th and 10th
NS54	Daylight water channel from White Center Regional Pond to Mallard Lake
NS57	Construct regional detention facilities and provide regulations for control of Miller Creek
NS58	Use combination of regulations, retrofits and capital projects for highways, roads and high-density developments to improve water quality on Miller Creek.
NS59	Complete combination of estuary restoration, culvert replacement, sewer manhole relocation, concrete weir removal and property or easement acquisition on Miller Creek
NS61	Restore Dockton Park by replacing deteriorating cross tiles and catch basins, and repair or remove bulkhead.
NS62	Acquire approximately 40 acres on Judd Creek to protect and conserve best spawning reach
NS63	Portage salt marsh habitat restoration project
NS65	Lower Shinglemill Creek habitat restoration.
NS66	Restore degraded in-stream, riparian and wetland habitat with cooperative property owners in the West fork of Judd Creek.
NSP9	Establish minimum instream flows for salmonid streams on Vashon and Maury Islands
NSP10/NS34	Programmatic purchasing of key parcels (~800 acres) in the Judd Creek watershed that contain coho/chum/cutthroat spawning habitat, riparian buffers, and headwater springs.

Green/Duwamish Ecosystem Restoration Study Projects (Not Included in Habitat Plan)

Name
Upper Green River Subwatershed
Northeast Creek Culvert
May Creek Culvert
Olsen Creek
Maywood Creek
Gold Creek
Middle Green River Subwatershed
Meridian Valley Creek
Lake Meridian Outlet
Lower Green River Subwatershed
Mill Creek East
Mill – Goedeke North Reach
Mill – Wetland 5K Reach
Mill – Merlino Reach
Upper Springbrook Creek
Garrison Creek
Duwamish Estuary Subwatershed
Elliott Bay Nearshore

H. FEASIBILITY AND EFFECTIVENESS PRIORITIZATION OF WRIA 9 HABITAT ACTIONS

1. Evaluation Approach

In addition to the Science Panel action evaluations, the WRIA 9 Steering Committee recognized the need to evaluate actions for their political and socioeconomic feasibility. This evaluation would serve as a secondary screen focused on community values. It would offer a "reality check" for those actions that may be scientifically feasible but impractical or unwise from a political, social, or economic perspective. Feasibility and effectiveness criteria would help identify actions that were practical, realistic, fair, and likely to be implemented if the Habitat Plan is approved. Using the feasibility and effectiveness criteria would help:

- Prioritize the most feasible/effective actions
- Identify those actions that have problems and correct those problems
- Identify actions that are fatally flawed

At the October 14, 2004, Watershed Services Coordination (WSC) staff provided possible frameworks and suggested 22 draft "feasibility and effectiveness" criteria to start the discussion. These criteria had earlier been developed by the Public Outreach Work Group and reviewed by the Planning Work Group. At the October 14 meeting, the Steering Committee agreed to an overall approach in which most actions would be evaluated qualitatively against most of the feasibility and effectiveness criteria. Steering Committee members reviewed each of the proposed criteria and revised and adopted the majority. The Steering Committee rejected several proposed criteria and added several new ones. The Steering Committee also authorized WSC staff at the same meeting to conduct a draft evaluation of actions using the resulting feasibility and effectiveness criteria later in the fall. In response to the concerns of individual Steering Committee members regarding the large number of criteria and using suggestions by individual Steering Committee members, WSC staff subsequently identified nine criteria as being the most valuable to use. Staff identified these priority criteria by evaluating each criterion in terms of: 1) the relative importance of each criterion and 2) the extent to which information is available to make a good evaluation of each action in terms of each criterion.

At their November 18, 2004, meeting, the Steering Committee agreed with this revised list of nine criteria. The Steering Committee asked staff to add two additional criteria to address "cost of action" in dollars and "negative financial impacts or other negative impacts to private property owners and other citizens." This produced a final list of 11 feasibility and effectiveness criteria. These criteria were tested against sample actions at first the November 30, 2004 public workshop and then at the December 1 and 9, 2004 meetings of the Steering Committee. The results from the two exercises were similar.

In January 2005 and June 2005, in accordance with the direction of the Steering Committee at its October 14, 2004, meeting, WSC staff reviewed draft actions using the feasibility and effectiveness criteria. The approach used by WSC staff was similar to that used by the WRIA 9 Technical Committee to prioritize Conservation Hypotheses and by the Science Panel to

prioritize on-the-ground actions. Actions were evaluated by subwatershed. Following a description of the action by the WSC subwatershed lead, each WSC staff person rated the action independently. This approach was used to avoid a sway in opinion before an individual decision could be made and to compensate in part for the smaller and less diverse perspectives of the WSC staff team as compared to the entire Steering Committee. The rating was then discussed to reconcile differences based on a simple majority, although consensus was typically reached on most actions. Notes were also reflected on the "Master" rating sheet for each action. Unlike the Science Panel evaluations, the feasibility and effectiveness evaluations did not result in a numerical ranking. Instead, the goal was to determine whether an action would be included in the action list for the Habitat Plan.

Similar to the Science Panel criteria, the feasibility and effectiveness criteria are based on "guiding principles" considered during development of the criteria. These guiding principles include:

Timing: Can the action be effective within ten years of plan implementation. There are multiple socioeconomic factors that influence project timing. A number of these are included in the feasibility and effectiveness criteria.

Uncertainty: Socioeconomic uncertainty is different than the scientific uncertainty linked to the NRC guidelines considered by the Science Panel. Socioeconomic uncertainty is linked to timing and is determinative of "serious flaws" that may exclude an action from the action list.

2. Criteria

The feasibility and effectiveness screening criteria fell into three broad categories:

- Determining Serious Flaws;
- Prioritizing Actions; and
- Other.

Generally, if an action had serious flaws it was eliminated from inclusion in the action list. This typically required at least two negative responses to the criterion within the serious flaws category. However, a professional judgment was ultimately arrived at for each action, and in some cases an action with two or more serious flaws may still have been included in the action list because of its overall importance to the subwatershed and an assumption that the serious flaws could be reduced or overcome. The prioritizing actions category allowed for an evaluation of timing and cost considerations. The "other" category addressed coordination and support considerations. The criteria and a brief rationale for each criterion are described below.

Determining Serious Flaws

1. Is the proposed action free of unacceptable risks to human health and safety?

The purpose of this criterion is to account for hazards specifically to humans that may result if an action were implemented. For example, placement of large woody debris (LWD) might pose a hazard to boaters in certain settings.

2. Is the proposed action free of unacceptable risk to private/public property?

The purpose of this criterion is to account for hazards to property that may result if an action were implemented. For example, removal of a levee or seawall might expose a property to unacceptable risk if some alternative form of protection were not provided. Evaluations of these criteria for some actions were based on the assumption that use of standard engineering practices would be sufficient to avoid or minimize such risks.

3. Is the action politically feasible?

The purpose of this criterion is to evaluate the potential political support for an action. For example, a regulation requiring substantial shoreline setbacks might lack political feasibility. This is a criterion, however, that could be evaluated differently if the political climate changed for a given issue or action. This criterion was also included to ensure adequate consideration of community support, which is an important factor in granting decisions by the state Salmon Recovery Funding Board. Evaluations using this criterion are often but not always correlated with evaluations using criterion 11 below.

4. Is the action free of potential negative impacts on land use?

The purpose of this criterion is to evaluate whether an unintended, undesirable land use impact would result if an action were implemented. For example, creating an off-channel habitat could change the location of shoreline jurisdiction affecting an upland property that previously did not fall within shorelines jurisdiction, and thus restrict the use of that property. This criterion was not intended to encompass intended changes to land use that might be seen as negative by some people. For example, the deliberate preservation of high value habitat lands or the purchase of degraded properties for habitat projects was not considered a negative impact although it would certainly restrict future land use on the subject properties.

5. Is the action free of potential negative financial impacts to private parties?

The purpose of this criterion is to evaluate whether an unintended financial impact would result if an action were implemented. Under the Shorelines example cited in the previous criterion, limiting the use of an upland property could also have a negative financial impact. In practice, a negative response to this criterion was often correlated with a negative response to criterion 4 above.

Prioritizing Actions

6. Will the proposed action benefit salmon in the next 10 years?

The purpose of this criterion is to determine if the action would provide a benefit to salmon within the first ten years of habitat plan implementation, the near-term horizon identified by Shared Strategies. While this Habitat Plan is a long-term plan, it emphasizes early ambitious actions to accelerate the pace of habitat recovery and meet the expected requirements of NOAA Fisheries.

7. Is there urgency to the action for non-scientific reasons?

The purpose of this criterion is to evaluate whether an action needs to be acted upon sooner than later so as not to lose an opportunity. "Non-scientific" in this case turned out to be a synonym for "non-salmon." For example, a property within the Urban area identified for acquisition may also face development pressure and failure to acquire it sooner rather than later might see the opportunity lost forever.

8. Are there other benefits to people (ecosystem goods and services)?

The purpose of this criterion is to determine whether there are ancillary benefits that accompany the action such as open space, habitat for other species, and water quantity and quality improvements.

9. Cost

The purpose of this criterion is to determine an approximate capital and/or annual programmatic costs of the action if feasible. In many cases cost estimates were not available or did not include factors such as Net Present Value, opportunity cost, or value of the ecosystem service being addressed.

Other

10. Can the action be coordinated with other actions?

The purpose of this criterion is consideration other "big initiatives" the action could be coordinated with. This criterion focused on "big initiatives" such as the Green/Duwamish Ecosystem Restoration Project, Tacoma Habitat Conservation Plan, Lower Duwamish Superfund cleanup, and others. Coordination could touch on funding, timing, and project features.

11. Is there support from affected people?

The purpose of this criterion is to evaluate whether those people most immediately affected (i.e. property owner, neighbors) would likely support the action. In practice, a "low" evaluation corresponded to expected opposition to the action, a "medium" evaluation corresponded to mixed support and opposition, and a "high" evaluation corresponded to expected widespread support. This was among the most subjective of rankings given that many of the actions evaluated have not yet been publicized.

3. Actions

Of a total of 150 actions evaluated using the feasibility and effectiveness screen, 142 emerged as strategic actions for the WRIA 9 Habitat Plan. Actions fall into three categories: 1) those on the ground projects that require construction, 2) property acquisitions, and 3) programs. Programs include a broad array of efforts including stewardship program, public education/outreach, incentives, and regulations (A number of actions offered as programs via the subwatershed meetings were determined by WSC staff to be policies or studies and therefore were not evaluated using the feasibility and effectiveness screen). Of the actions, 53 are on the ground

actions that were first evaluated by the Science Panel, 57 are property acquisitions, and 32 are programmatic actions. Ideally, the programmatic actions would have been evaluated for their scientific and technical merit before being evaluated for feasibility and effectiveness. However, time constraints prevented the use of such a screen. Moreover, the scientific/technical screen used for on-the-ground projects would have to be revised to accommodate the qualitatively different nature of programmatic actions. Programmatic actions could be further evaluated using a scientific and technical screen between the draft and final habitat plan.

It is important to note that the evaluation using feasibility and effectiveness criteria did reveal substantial problems with some of the actions listed below. However, the importance of the actions and the belief that many of the flaws can and should be overcome has led to the inclusion of the actions. For example, a number of habitat rehabilitation/substitution projects in the Duwamish and on the Green River mainstem are currently infeasible due to their impacts on shoreline boundaries. This obstacle, while formidable, is inherently a political/regulatory problem that *can* be solved and, given the pattern of development in the watershed, *must* be solved to allow projects that ranked high scientific/technical grounds.

Acquisitions: All 51 Vashon/Maury Island acquisitions and six King County proposed Last Best Places Middle Green acquisitions passed the feasibility and effectiveness screen.

Ecological Restoration Projects (ERP): All Chinook oriented ERP projects that are not limited by an FPP (Farmland Preservation Property) designation are considered WRIA 9 "Actions." Because these ERP projects are funded and in many cases underway they were not evaluated under the feasibility and effectiveness screen.

Actions that did not pass the feasibility and effectiveness screen:

NS3- Remove armoring-South Magnolia

MG B2-Levee setback because of FPP designation

LG 48-NE Auburn tributary fish passage because of FPP designation

LG 55-Reddington Levee because of FPP designation

NSP 9-Set minimum flows of Vashon and Maury Island streams because Chinook benefits are small

NSP 10-Judd Ck. conservation program

D 15-Protect Puget Ck basin

D 16- Protect Hamm Ck basin

Science Panel Evaluated Actions that Passed Feasibility and Effectiveness Screen (12/04)

	Action ID	Action Description
Upper Green	UG1[a]	Provide Chinook access above Howard Hanson Dam
	UG 29 & UG30	Gale Creek and Boundary Creek culvert replacement
	UG44	Creation of off-channel habitat (RM 77.9 - 88.3)
	UG40	Creation of off-channel habitat (RM 67.75 - 75.5)
	UG50	Restoration off-channel habitat (RM 67.75 - 84.1)
	UG29	Gale Creek culvert replacement
	UGX	USFS road decommissioning
	UG16	Mainstem Green River (El. 1240 - 1480)
	UG42	Restore lateral channel migration (RM 72 -73.5 right bank)
	UG43	Restore lateral channel migration (RM 76.2 - 78.5)
	UG45	Restore lateral channel migration (RM 79.3-80.5 left bank)
	UG49	Restore lateral channel migration (RM 87 - 88 left bank)
	UG46	Restore lateral channel migration (RM 80.7 +- right bank)
Middle Green	MG A1	Middle Green Blueprint - floodplain reconnection, side channel inlet connection, site-specific LWD, meander logjam, gravel addition, invasive plant control, and riparian revegetation
	MG A2	Middle Green Blueprint - side channel construction/floodplain reconnection, meander logjam, gravel addition, invasive plant control, and riparian revegetation
	MG D2	Setback of Hamakami, Horath, and Kaech levees, logjam/wood addition, floodplain reconnection, Japanese knotweed removal, and riparian revegetation
	MG D3	Middle Green Blueprint - Neely and Porter levees setback, logjam/wood addition, floodplain reconnection, Japanese knotweed removal, and riparian vegetation
	MG E2	Pautzke levee removal, logjam/wood addition, floodplain reconnection, Japanese knotweed removal, and riparian revegetation
	MG 1	Porter levee setback
Lower Green	LG8	Sheep pasture acquisition: Revetment setback and off-channel habitat rehabilitation (Nelson Side-Channel)
	LG30	Boeing Levee setback and habitat rehabilitation (combined with Frager Rd (LG 32) and Russell Rd (LG 31) projects)
	LG27	Johnson Creek/Gunter Levee Acquisition and off-channel habitat rehabilitation *(revised)*
	LG35	Rosso Nursery site off-channel rehabilitation and riparian restoration
	LG45	Auto wrecking yard acquisition: revetment setback, floodplain wetland restoration; and off-channel habitat rehabilitation
	LG26	Briscoe Meander Levee setback and off-channel habitat rehabilitation
	LG3	Fort Dent Levee setback
	LG23	Downstream end of Desimone Levee ROW Acquisition, levee setback and habitat rehabilitation
	LG52	Horsehead Bend off-channel habitat rehabilitation
Duwamish Estuary	DUW26	Shallow water habitat at RM 5.5 - 7.0 (large version; 20 acres)
	DUW30	Cease maintenance dredging in Turning Basin area (RM 5.0 - 5.5)
	DUW44	Hamm Creek/City Light North estuary/shallow water habitat (large version; 15 acres)
	DUW6	Off-channel and reshaped bank construction (RM 9.9 - 10.3)
	DUW16	42nd Street revetment setback; LWD; revegetate
	DUW27[b]	Hamm Creek/City Light North estuary/shallow water habitat (small version; 7 acres)
	DUW23	North Winds Weir: Create 2 acres of off-channel habitat
	DUW25[b]	Shallow water habitat at RM 5.5 - 7.0 (small version; 5 acres)
	DUW37	Kellogg Island rehabilitation
	DUW8	Wastewater pipeline crossing retrofit (RM 8.9)
	DUW17	South 115th Street revetment setback; LWD; revegetate
	DUW24	Revegetation of LB -- RM 7.3 - 8.0
	DUW12	Gateway South revetment setback

	Action ID	Action Description
	DUW32	South Park Duwamish Revival
Marine Nearshore	NS18	Seahurst Park shoreline restoration, Phase 2
	NS4	Expand shallow water habitat east of Pier 90
	NS64	Raab's Creek and estuarine restoration
	NS27a	Open access by replacing culverts at mouths of Mileta Creek, Ellisport Creek, Camp Sealth, Bates, Tsugwalla, and Dilworth creeks
	NS5	Olympic Sculpture Park Tidal Embayment and Shallow Subtidal Habitat
	NS6	Pocket beaches in Myrtle Edwards Park and north
	NS9-10	Create shallow water bench habitat at multiple locations along Seattle waterfront
	NS 26	Salt marsh and protection and restoration at mouth of Ellis Ck.

Notes: a) Providing upstream passage for Chinook to access the Upper Green River did not rank as a Tier 1 action; however, it is an assumed action to precede all other Upper Green proposed actions. The scoring of all other Upper Green proposed actions assumed that passage for Chinook will have been provided.
Please note that these two proposed actions in the Duwamish estuary are smaller versions of proposed actions that were scored higher.

Programs that Passed Feasibility and Effectiveness Screen (12/04) [a]

	Action ID	Action Description
Middle Green	MGP-1	Enumclaw Plateau Dairy Nutrient Management Program
Duwamish Estuary	D-1	Eliminate perennial pepperweed
	D-2	Eliminate phragmites
Marine Nearshore	NSP-1	Promote habitat restoration on private property by offering a "toolbox" of near shore restoration habitat projects.
	NSP-2	Create soft armoring technical assistance and cost-share program.
	NSP-3	Create a financial incentive program to encourage multiple family/neighborhood use over water structures and boat ramps.
	NSP-4	Create a financial incentive program to replace/repair failing septic systems at Quartermaster Harbor.
WRIA-Wide	WW-1a-1j [b]	Ten Education/outreach programs including stewardship workshops, water conservation programs, natural yard care programs, and expanded basin steward program.
	WW-2	Expand/Improve incentives programs (e.g., TDR, PBRS, forest cover and low impact development fee reduction.
	WW-3	Improve enforcement of existing land use regulations.
	WW-4	Modify Shoreline Management Act to Encourage Habitat Restoration
	WW-5	Increase use of low impact development and porous concrete.
	WW-6	Promote development according to Built Green Checklists.
	WW-7	Develop a coordinated open space acquisition program
	WW-8	Develop salmon restoration tools consistent with agricultural land use.

[a] WCS staff determined that those programmatic actions proposed for the he Upper, Middle, and Lower Green were actually a combination of polices and studies and as such are reflected in the relevant sections in this plan.
[b] The ten actions were evaluated as a whole because of their similarities and the same identical outcome if evaluated individually.

Use of the Evaluation Tools for Future Actions

A hallmark of the WRIA 9 Habitat Planning process is that it has established and adopted two action evaluation screens that can be used to evaluate future actions. This is an important consideration in implementation of the habitat plan. As our knowledge of the watershed and salmon recovery science increases and as funding priorities change the habitat plan must be flexible enough to consider new actions and reconsidered previously evaluated actions. Establishing the criteria and methodology for evaluating the scientific and feasibility and effectiveness of proposed actions is therefore an essential tool for plan implementation and adaptive management.

I. OVERVIEW OF SITE-SPECIFIC COSTS

PRELIMINARY COST ESTIMATE RANGE OF SITE SPECIFIC PROJECTS

Introduction

The purpose of the preliminary cost estimate range is to provide "ballpark" costs, not actual costs, of the projects included within the WRIA 9 Habitat Plan. The WRIA 9 Habitat Plan projects are high priority, site specific projects selected from a comprehensive list of projects and actions. The list of projects was developed through a sequence of subwatershed-focus and public meetings with participation of local stakeholders, jurisdictional staff, environmental and business representatives, project experts, and citizens. The projects were reviewed by the WRIA 9 Science Panel for technical merit, and screened by the WRIA 9 staff members for feasibility and effectiveness flaws. The project proposals were developed without consideration of costs, in order to identify projects and actions with the highest benefit to Chinook salmon. Costs are preliminary estimates in 2005 dollars and are not inflated for future years.

This is a preliminary and partial cost estimate range. The project list will likely change as design plans evolve and projects are added or subtracted over time. Estimated costs are based upon early concepts as well as currently available project proposals. Most project concepts will be developed as public and local government comments are incorporated into the plan.

Several of the proposed projects are large, encompassing several segments. A few types of habitat projects, including riparian planting and fencing, have been in wide use for years and few variables affect costs. These conditions result in greater predictability and precision in estimating costs. Other types, such as major floodplain and estuary restoration projects, are more experimental in nature and variable in characteristics, with costs that are much more difficult to predict. Because of the variability in the precision of the estimates and the inherent difficulty of generalizing about costs of widely differing projects, there are bound to be cases where the cost estimates appear to be off or even incorrect. The costs estimates will be revised as additional information on the project scope, design, materials, permitting and other factors become available.

The costs of salmon recovery in this region will be high, but when implemented, the plan will address recovery concerns over a large geographic area and over a long period of time.

The cost estimate range for the WRIA 9 Habitat Plan projects was developed using the Primer on Habitat Project Costs (Evergreen Funding Consultants, 2003). Assumptions about average project conditions were made so as to cost projects in groups, rather than individually. The reliability of the group subtotals depends to an extent on the validity of the assumptions used to assign projects to groups. Non-average characteristics of the projects may not be apparent until the design and engineering process is advanced. Additional project cost information was provided from other sources including the Green/Duwamish Ecosystem Restoration Study Final Feasibility Report (U.S. Army Corps of Engineers, October, 2000); Howard Hanson Addition

Water Storage-Phase I (U.S. Army Corps of Engineers, July, 2000), as well as personal communications from project managers.

These cost estimates should be regularly updated and refined as the projects are developed. As budgets are developed for individual projects, real costs should be substituted for the estimates.

Table I-1: WRIA 9 Habitat Plan Project Cost Estimate Range Summary

Group	Group Description	Number Projects	Cost Estimate Range	
Acquisition			**Low**	**High**
A2	Low development potential, far from an urban area	1	$149,400	$298,800
A3	Low development potential, close to an urban area	1	$720,000	$1,440,000
A5	Medium development potential, medium amenity value	2	$1,139,000	$2,715,000
A6	Medium development potential, high amenity value	1	$180,000	$280,000
A12	High development potential, high amenity	3	$16,600,000	$30,337,000
A17	Very high development potential, medium amenity value	1	$9,000,000	$18,000,000
A19	Easement on very high development potential, medium amenity	2	$9,990,000	$19,650,000
Mixed	Combined categories	2	$35,094,419	$42,276,507
Floodplain				
F2	Complex reconnection; low stream energy	1	$148,000	$259,000
F3	Channel reconstruction; low stream energy	2	$192,000	$279,000
F5	Complex reconnection; medium stream energy	1	$70,000	$100,000
F6	Channel reconstruction; medium stream energy	2	$650,000	$1,300,000
F7	Simple reconnection; high stream energy	1	$130,000	$200,000
F9	Channel reconstruction; high stream energy	3	$1,880,000	$2,820,000
Streambank				
S5	Streambank improvements on medium waterways with moderate earthmoving	1	$198,000	$330,000
S7	Streambank improvements on medium waterways with substantial earthmoving	2	$1,367,000	$2,420,000
S8	Streambank improvements on large waterways with moderate earthmoving	7	$5,453,600	$9,543,800
S9	Streambank improvements on large waterways with substantial earthmoving	8	$12,921,729	$20,084,474
Large Woody Debris				

Group	Group Description	Number Projects	Cost Estimate Range	
W6	Wood placement (large logs) in medium waterway	1	$450,000	$630,000
W8	Wood placement (medium logs) in large waterway	2	$240,000	$420,000
W9	Wood placement (large logs) in large waterway	4	$595,000	$680,000
Riparian Enhancement				
R1	Simple riparian enhancement; easily accessible site	1	$30,000	$60,000
R2	Somewhat complex riparian enhancement; easily accessible site	4	$330,000	$660,000
R3	Complex riparian enhancement; easily accessible site	1	$66,000	$99,000
R4	Simple riparian enhancement; somewhat accessible site	1	$450,000	$900,000
R8	Somewhat complex riparian enhancement; difficult access to site	1	$4,500,000	$7,500,000
Estuarine				
E2	Undeveloped site - moderate excavation/average transportation distance	1	$32,000	$48,000
E5	Somewhat developed site - moderate excavation/average transportation distance	5	$9,000,000	$18,000,000
E6	Somewhat developed site - considerable excavation/moderate transportation distance	3	$3,150,000	$8,400,000
E9	Highly developed site - substantial excavation/ moderate transportation distance	2	$10,589,744	$32,709,232
Nearshore				
N6	Major reconstruction; average distance	10	$1,387,500	$4,625,000
Other				
U.S. Army Corps of Engineers Additional Water Storage Project	Army Corps of Engineers Additional Water Storage	1	$45,000,000	$45,000,000
ERS + EC	Ecosystem Restoration Study + Evergreen Consultants	1	$335,890	$445,926
Personal Communication		3	$6,372,610	7,225,558
ERS	Project cost information (Some project costs may be listed under other headings)	26	$33,184,840	$37,934,165
Complex project	S9 project used as base	1	$1,400,000	$2,800,000
No cost information	Contamination clean-up/removal; road relocation; bridge replacement; house purchase; house removal;	5		
ERS + KC	DUW -10	1	$1,790,000	$2,049,000

Group	Group Description	Number Projects	Cost Estimate Range	
Culvert replacement	Evergreen Consultants	3	$651,000	$1,259,800
SRFB	Salmon Recovery Funding Board	3	$2,845,662	$3,216,823
GRFCZD	Green River Flood Control Zone District	3	$35,715,000	$40,889,401
SAM costs	Seattle Art Museum and similar projects	3	$18,128,208	$20,425,570
EC & GRFCZ	Evergreen Consultants and Green River Flood Control Zone District	1	$280,000	$420,000
	Total		**$272,406,602**	**$388,731,056**

Table I-2: WRIA 9 Habitat Plan Project Preliminary Cost Estimates

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
Upper Green River Subwatershed							
UG-1	**Revegetation of Sunday Creek:** Re-plant 2.9-mile stretch along Sunday Creek with small riparian plants to improve salmonid habitat/temperature, add large woody debris; RM 84.1	$2,815,960; ERS		$2,815,960	$3,013,077	$3,223,993	ERS costs + 13%
UG-2	**Instream Habitat Improvement:** Improve channel and riparian area, place meander jams, bar apex jams, barb jams, introduce woody debris, reconnect side channels; RM 82-73, El. 1240-1480						Reconnect 1 side-channel, 2 locations 50'x300 for .75 acre
UG-2A	Woody debris	W6: $50,000-$70,000 per RM;	9 RM	$450,000	$540,000	$630,000	
UG-2B	Side channel	F7: $130,000-$200,000/ acre	1 acre	$130,000	$165,000	$200,000	
UG-3	**Culvert Replacements in Gale and Boundary Creeks**: Implement culvert replacements; near RM 67, Road 5530 and 5530A @ mile-post 11.5	$285,890 + $50-$100K	1bridge + culvert	$335,890	$389,479	$445,926	ERS costs (+13%) for Gale Creek bridge; EC costs for Boundary Creek bottomless arch
UG-4	**Fish Passage To and From the Upper Green River subwatershed:** Provide Chinook access above Howard Hanson dam; RM 64.5	U.S. Army Corps of Engineers		$45,000,000	$45,000,000	$45,000,000	This is a downstream fish passage facility at Howard Hanson Dam; Tacoma completed the fish ladder and trap-and-haul system to pass fish upstream over the dams. Project scheduled for completion in near future. Cost estimate from U.S. ARMY Corps of Engineers Additional Water Storage

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
							Project in 2005.
UG-5	**Restore/Rehabilitate Habitat Through Forest Logging Road Improvements:** Support implementation of US Forest Service/Washington State Department of Ecology road maintenance and abandonment. Specific location TBD	$36,500/ RM	10 miles	$365,000	$380,000	$395,000	S2 - $100/ lineal foot
5 Projects	**Total Estimated Subwatershed Costs**			**$49,096,850**	**$49,487,556**	**$49,894,919**	
Middle Green River Subwatershed							
MG-1	**Upper (Middle) Green River Side Channels:** Restore natural process of sediment supply/transport and large woody debris to 2 side channels; RM 60	$676,870; ERS		$676,870	$724,251	$774,948	ERS Construction Costs + 13%
MG-2	**Brunner Slough (Kanaskat North):** Provide off-channel winter and summer rearing and refuge habitat for salmon/trout; RM 58	$1,180,850; ERS		$1,180,850	$1,263,510	$1,351,955	ERS Construction Costs + 13%
MG-3	**Flaming Geyser Floodplain Reconnection, Side Channel Connection, and Habitat Restoration:** Excavate portion of floodplain to reconnect floodplain with river, side channel inlet connection, site-specific large woody debris, gravel addition, invasive plant control, and riparian revegetation; RM 45.1-44.3						Washington State Park land
MG-3 A	Floodplain Reconnection;	S7: $150-400/lineal foot;	4,600' edge removal;	$1,150,000	$1,265,000	$1,840,000	Includes some planting and wood
MG-3 B	Side channel inlet connection;	F3: $60-90K/acre;	.6 acre channel reconnection;	$36,000	$45,000	$54,000	
MG-3 C	Site specific logjam addition; Reach-wide logjam and wood	W9 (@50% to account	10 log structures	$350,000	$370,000	$400,000	

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
	addition;	for F8 wood) $35-40K per structure;					
MG-3 D	Gravel addition	ERS costs	6,000 tons	$169,500	$177,975	$186,450	
MG-3 E	Japanese knotweed removal; riparian revegetation;	Planting for area beyond S7 area; R4: $10-20K/acre	45 acres	$450,000	$675,000	$900,000	
MG-4	**Flaming Geyser Side Channel Construction, Floodplain Reconnection:** Construct a side channel to increase amount of off-channel habitat; includes floodplain reconnection, meander logjam, gravel addition, invasive plant control, and riparian revegetation; RM 44						
MG-4 A	Bank setback	S7: $150-400/lineal foot; ;	1450 lineal feet	$217,000	$398,750	$580,000	
MG-4 B	Side channel construction;	F3: $60-90K/acre;	2.5 acres	$156,000	$187,500	$225,000	
MG-4 C	Reach-wide logjam and wood addition;	W9 (@50% to account for F8 wood) $35-40K per structure	1 log structure;	$35,000	$37,500	$40,000	
MG-4 D	Gravel addition;	ERS costs	6,000 tons	$169,500	$177,975	$186,450	
MG-4 E	Japanese knotweed removal; A14 - riparian revegetation;	R1: $5-10K/acre;	6 acres/ planting	$30,000	$45,000	$60,000	
MG-5	**Flaming Geyser Slide:** Eliminate large source of fine sediment from reach; RM 43	$3,796,800; ERS		$3,796,800	$4,062,576	$4,346,956	ERS construction cost + 13%
MG-6	**Newaukum Creek:** Restore process-based ecological functions including wetland and riparian restoration; RM 0-14.3 (both banks)	$4,348,240; ERS		$4,348,240	$4,652,617	$4,978,300	ERS construction cost + 13%

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
MG-7	**Big Spring Creek:** Re-locate a major section of creek away from roadside ditch into channel consistent with historic route;	$1,116,440; ERS		$1,116,440	$1,194,590	$1,278,212	ERS construction cost + 13%
MG-8	**Newaukum Creek Mouth Restoration:** Place large woody debris, control invasive plants, plant native plants; RM 0.3-4.3	$938,581; SRFB		$938,581	$1,004,281	$1,074,581	Salmon Recovery Funding Board Grant Application Costs; cost increases 7% between categories
MG-9	**Lones Levee Removal:** Restore natural channel migration processes, consistent with current flow regimes of the Green River; RM 38	$2,913,140; ERS		$2,913,140	$3,117,059	$3,335,254	ERS construction cost + 13%
MG-10	**Burns Creek:** Enhance salmonid habitat in Burns Creek while reducing property damage associated with flooding and channel aggradation (sediment buildup); RM 38	$421,490; ERS		$421,490	$450,994	$482,564	ERS construction cost + 13%
MG-11	**Turley Levee Setback:** Reconnect floodplain area of the Green River allowing natural processes to be re-established including creation of side channel habitat; RM 37	$194,360; ERS		$194,360	$207,965	$222,522	ERS construction cost + 13%
MG-12	**Levee Setback to Reconnect Floodplain and Allow Channel Migration:** Remove levee to reconnect floodplain, allow channel migration and construct revetment at edge of project to protect against erosion; RM 36						GRFCZD - costs for levee removal = $1,000/lineal foot, levee setback = $1,500
MG-12 A	Acquisition	A2: $1,800-$3,600	83 acres	$149,400	$199,200	$298,800	
MG-12 B	Hamakami revetment removal/setback to Green Valley Road;	S8: $400-$700/lineal foot	1,500 ' levee setback	$600,000	$825,000	$1,050,000	
MG-12 C	Horath Levee setback to Green Valley Road;	S8: $400-$700/lineal foot	1,000'	$400,000	$550,000	$700,000	
MG-12 D	Kaech Levee setback to Green Valley Road'	S8: $400-$700/lineal foot	700'	$280,000	$385,000	$490,000	
MG-12 E	Logjam and wood addition	W9: $70-80K/	1 LWD jam in	$70,000	$75,000	$80,000	

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
		structure	addition to wood in levee setback				
MG-12 F	Floodplain reconnection south of Green Valley Road, and Green Valley Road Relocation/floodplain reconnection;	Included in levee setback costs					
MG-12 G	Japanese knotweed removal and reach-wide invasive plant control; Riparian revegetation management	R2: $10-$20K/acre	4 acres additional invasive control and planting	$40,000	$60,000	$80,000	
MG-13	**Hamakami Levee:** Re-connect floodplain of existing forested wetland to river, providing refuge/rearing for salmonids; RM 36	$649,750; ERS		$649,750	$695,233	$743,899	ERS construction cost + 13%
MG-14	**Kaech Side Channel:** Re-connect side channel and wetland for refuge and rearing habitat	$266,680; ERS		$266,680	$285,348	$305,322	ERS construction cost + 13%
MG-15	**Neely and Porter Levees Setback and Floodplain Reconnection:**						
MG-15 A	Levee setback and floodplain reconnection	S8: $400-700/lineal foot	5400 feet	$2,160,000	$2,970,000	$3,780,000	
MG-15 B	Replace Neely Bridge	Info not available					Longer structure needed for channel migration
MG-15 C	Logjams and large woody debris	W8: $40-70K per structure	2 log jams	$80,000	$110,000	$140,000	
MG-15 D	Riparian vegetation restoration	R8: $30-50K per acre	150 acres	$4,500,000	$6,000,000	$7,500,000	Required acreage not provided in description; planting provided in levee setback so this is additional
MG-15 E	Acquisition	A3:$2,400-$4,800	300 acres	$720,000	$960,000	$1,440,000	Acquisition is complex because some properties in FPP

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
MG-16	**Ray Creek:** Restore riparian corridor and allow natural processes to be re-established to enhance salmonid rearing/refuge within the stream	$2,241,920; ERS		$2,241,920	$2,398,854	$2,566,774	ERS construction cost + 13%
MG-17	**Porter Levee Setback and Floodplain Reconnection:** Removing existing levee and setback to toe of Green River Valley Road; RM 34	$974,000;ERS		$974,000	$1,022,700	$1,071,466	ERS Project construction cost + 13%
MG-18	**Setback and Removal of Fenster and Pautzke Levees to Reconnect Floodplain and Allow Channel Migration: R**emove levees, lower elevation of terraces, and construct logjams to reinstate floodplain connectivity and channel migration; RM 32						GRFCZD - costs for levee removal = $1,000/lineal foot, levee setback = $1,500
MG-18 A	Remove levee; Floodplain reconnection	S8: $400-$700/lineal foot	1,650'	$660,000	$907,500	$1,155,000	
MG-18 B	Logjam and wood addition	W8: $40-70K per structure	4 large wood jams	$160,000	$220,000	$280,000	
MG-18 C	Reach-wide invasive plant control; riparian revegetation;	R2: $10-20K/acre	12 acres (reduced for levee removal area)	$120,000	$180,000	$240,000	
MG-19	**Acquisitions to Protect High Quality Habitat:** Seven locations in Middle Green Subwatershed to protect currently functioning habitat;		Total acres: undeter-mined	$23,739,000	24,925,950	26,172,248	
19 Projects	**Total Estimated Subwatershed Costs**			**$56,160,521**	**$62,827,328**	**$70,410,701**	
Lower Green River Subwatershed							
LG-1	**Riverside Estates Side Channel:** Re-establish side channel to provide summer rearing habitat and winter refuge and maintain flood protection; RM 28.8	$503,980; ERS		$503,980	$539,259	$577,007	ERS Project construction cost + 13%

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
LG-2	**Olson Creek:** Improve access to tributary from Green River, enhance habitat, restore natural processes, provide summer/winter rearing and refuge habitat for salmon; RM 28.5	City of Auburn cost est.		$700,000	$800,000	$900,000	City of Auburn ERS Project
LG-3	**Horsehead Bend:** Excavate off-channel habitat for rearing/refuge; RM 26	$604,550; ERS		$604,550	$646,869	$692,149	ERS Project construction cost + 13%
LG-4	**Off-Channel Habitat Rehabilitation:** Excavate off-channel flood refugium, restore floodplain, wetland, add woody debris, revegetate; "horsejaw/horseneck" site; RM 25.9						
LG-4 A	Channel re-connection	F 6: $100-200K per acre;	1,500 lineal feet of off channel x 50' width = 2.5 acres	$250,000	$375,000	$500,000	
LG-4 B	Levee setback	S8: $400-$700/ lineal ft	1,800'	$720,000	$990,000	$1,260,000	
LG-5	**NE Auburn Creek:** Eliminate existing flapgate and culvert, daylight and enhance tributary by increasing creek diversity; install bridge to maintain access across channel; riparian vegetation; RM 25.6	$732,240; ERS		$732,240	$783,497	$838,342	ERS Project construction cost + 13%
LG-6	**Acquisition, Revetment Setback, Floodplain Wetland Restoration and Off-Channel Habitat Rehabilitation:** Acquire and remove auto wrecking yards; remove contaminated soils, re-slope revetment, restore floodplain wetland and off-channel refuge, install woody debris and riparian vegetation. rehabilitation; RM 25.1-24.3 LB						
LG-6 A	Acquisition	A 5: $24k-$60K/acre	34 acres	$815,000	$1,632,000	$2,040,000	
LG-6 B	Revetment setback	S 9: $700-$1,000	2,600'	$1,820,000	$2,210,000	$2,600,000	

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
LG-6 C	Off-channel habitat	F 2: $40-70K/acre	3.7 acres	$148,000	$203,500	$259,000	
LG-6 D	Contamination removal	Unknown					Costs not available; possible grant for clean-up
LG-7	**Lower Mill Creek, Riverview (Formerly Green River) Park, Hawley Road Levee, and Lower Mullen Slough:** Restore habitat along the mainstem and lower sections of Mill Creek and Mullen Slough; RM 24-21.3						
LG-7 A	Lower Mill Creek: Restoration of lower .3 miles of Mill Creek and adjacent segments of armored riverbank; excavation of off-channel habitat, reshaping stream banks and Green River bank;	SRFB		$968,400	$1,016,820	1,067,661	Costs from SRFB grant application
LG-7 B	Riverview Park**:** Excavate off-channel area, add large woody debris and revegetation;	$337,870; ERS		$337,870	$361,521	$386,827	ERS Project construction cost + 13%
LG-7 C	Hawley Revetment: Set back oversteeped revetment, create low vegetated bench, install large woody debris;	GRFCZD: $1,500/ lineal foot	.2 of mile	$1,584,000	$1,694,880	$1,813,521	Cost increases = 7%
LG-7 D	Lower Mullen Slough (Also known as Prentice Nursery Reach)**:** Restore mouth of Mullen Slough to create a new flatter gradient;	$379,680; ERS		$379,680	$406,258	$434,696	ERS Project construction cost + 13%
LG-7 E	Mullen Slough: Restore slough by meandering channel, add large woody debris, riparian planting;	$820,380; ERS		$820,380	$877,807	$939,253	ERS Project construction cost + 13%
LG-7 F	Lower Mill Creek Future Project: Additional Planting and levee setback;	EC & GRFCZD	4 acres planting; 200' levee	$280,000	$350,000	$420,000	
LG-8	**Schuler Brothers Reach:** Increase channel diversity including dendrites, add large woody debris and riparian vegetation; RM 2.1-0.3 on Mill Creek;	$2,577,530; ERS		$2,577,530	$2,757,957	$2,951,014	ERS Project construction cost + 13%
LG-9	**Rosso Nursery Off-Channel Rehabilitation and Riparian Restoration:** Remove fill, excavate off-channel refuge, revegetate; RM 20.8-20, LB	F9: $200-$300K/acre	5.4 acres along river;	$1,080,000	$1,350,000	$1,620,000	Negotiations for purchase of property continuing.

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
LG-10	**Mainstem Maintenance (including Boeing Levee Setback and Habitat Rehabilitation):** Improve fish habitat along Lower Green River while providing stable bank and levee conditions to protect human infrastructure/development. RM 32-17	ERS					GRFCZD: costs for levee setback = $1,500/lineal foot
LG-10 A		S9: $700-1,000/lineal foot	.7 miles = 3,696 '	$554,400	$1,016,400	$1,478,400	Levee has been setback; need to complete riverbank work
LG-10 B		GRFCZD	4.3 miles = 22,704'	$34,056,000	$36,439,000	$38,990,000	GRFCZD: costs for levee setback = $1,500/lineal foot
LG-11	**Acquisition and off-Channel Habitat Rehabilitation of Johnson Creek:** Excavate flood refuge for juvenile salmonid habitat, realign stream channel, improve fish passage and restore wetland complex; RM 17.3-16.0 and RM 0-0.5 Johnson Creek						
LG-11 A	Acquisition of levee easement	A19: $300-$600K/acre	30 acres	$9,000,000	$13,500,000	$18,000,000	
LG-11 B	Off-channel habitat (Johnson Creek re-alignment)	F6: $100-$200k/acre	4 acres	$400,000	$600,000	$800,000	
LG-11 C	LWD	W9: $70-$80K/ structure	2 structures	$140,000	$150,000	$160,000	
LG-11 D	7 acre embayment - levee setback and creation of shallow water habitat	More complex than S9: $1,000 - used at low end of calcs.	1400 lineal feet	$1,400,000	$2,100,000	$2,800,000	
LG-11 E	Wetland restoration	R2: $10-$20K/acre	7 acres	$70,000	$105,000	$140,000	
LG-12	**Briscoe Levee Setback and Off-Channel Habitat Rehabilitation:** Remove armoring on shoreline, excavate flood refuge, install large woody debris, plant riparian vegetation; RM 16.10- 15.8						Levee setback - use GRFCZ for upper end of costs; 1,000' off channel x 50' width = 1.15 acre

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
LG-12 A	Levee setback	S8: $400-$700/ lineal ft	.3 RM = 1,584 lineal feet;	$633,600	$871,200	$1,108,800	
LG-12 B	Off channel reconnection	F5: $70-$100K/acre	900' off-channel = 1acre	$70,000	$85,000	$100,000	
LG-13	**Acquisition, Levee Setback, and Habitat Rehabilitation:** Setback over-steepened levee, create bench habitat, install large woody debris, plant native riparian vegetation; Downstream end of Desimone Levee, RM 15.3-14.7	S 9: $700-$1,000/lineal foot;	.7 RM = 3,696 lineal feet	$2,587,200	$3,104,250	$3,696,000	Riverfront ROW easement acquisition
LG-14	**Off Channel and Wetland Habitat Creation:** Construct side-channel connecting 10 acres of wetlands; RM 13.5-12.5, (right bank)						
LG-14 A	Side-Channel Construction	F-9: $200-$300K/acre	3 acres	$600,000	$750,000	$900,000	
LG-14 B	Wetland rehabilitation	R2: $10-$20K/acre	10 acres	$100,000	$150,000	$200,000	
LG-15	**Habitat Rehabilitation:** Restore historic flood refugia and off-channel rearing habitat in a riverside sheep pasture owned by City of Tukwila; RM 12.65-12.5						
LG-15 A	Side channel reconnection	F-9: $200-$300K/acre	1acre	$200,000	$250,000	$300,000	
LG-15 B	Levee setback	S9: $700-$1,000	1,200 lineal feet	$840,000	$1,020,000	$1,200,000	
LG-16	**Gilliam Creek:** Eliminate fish barriers and improve approximately 2000 feet of creek while maintaining flood protection; RM 12.5	$629,410; ERS		$629,410	$673,469	$720,612	ERS Project construction cost + 13%
LG-17	**Levee Setback:** Set back Fort Dent levee to create low vegetated bench (without affecting soccer fields or trail), add riparian vegetation and large woody debris; RM 12 - 11.15	S 5: $150-$250/lineal foot;	.1,320 lineal feet	$198,000	$264,000	$330,000	
LG-18	**Black River Marsh:** Improve site as emergent marsh, improving access for salmonid refuge and rearing; RM 11	$45,200; ERS		$45,200	$48,364	$51,749	ERS Project construction cost + 13%

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
LG-19	**Lower Springbrook Reach:** Create natural habitat for rearing and storm refuge; RM 1.0	$4,361,500; ERS		$4,361,500	$4,666,805	$4,993,481	ERS Project construction cost + 13%
19 Projects	**Total Estimated Subwatershed Costs**			**$70,206,940**	**$82,788,856**	**$95,268,512**	
Duwamish Estuary Subwatershed							
DUW-1	**Shallow Water Habitat Creation (15 Acres):** Create a minimum of 15 acres of off-channel shallow water/marsh habitat, with riparian vegetation; RM 11-7.0 (both banks)						
DUW-1 A	Acquisition	A12: $400-$731K/acre	15 acres	$6,000,000	$8,250,000	$10,965,000	Values increased per N. Wind's Weir property cost
DUW-1 B	Off-Channel area	E5: $250-$450K/acre	10 acres	$2,500,000	$3,500,000	$4,500,000	
DUW-2	**Shallow Water Habitat Creation and Bank Reshaping:** Create off-channel, shallow water refuge habitat, and set back and reshape bank, add large woody debris, revegetate; RM 10.3-9.9						GRFCZD: $1,500 per lineal foot for levee setback.
DUW-2 A	Acquisition	A12: $400-$731K/acre	3.5 acres	$1,400,000	$1,925,000	$2,559,000	
DUW-2 B	Off-Channel area	E6: $300-$800K/acre	2 acres	$600,000	$1,100,000	$1,600,000	
DUW-3	**Bank Restoration and Revetment Setback**: Reshape/setback revetment at Gateway South add large woody debris, revegetate, re-locate trail; RM 8.9-8.6; 8.4-8.2 (left bank)	S 9: $700-$1,000/lineal foot	.5 RM = 2640 lineal feet	$1,848,000	$2,244,000	$2,640,000	
DUW-4	**Wastewater Pipeline Crossing Retrofit:** Determine extent of alteration of salinity; retrofit if necessary; RM 8.0						Additional evaluation needed
DUW-5	**42nd Ave. S Bank Restoration:** Work with community to improve riparian habitat conditions; relocate water main and create shallow bench for habitat; add large woody debris and riparian vegetation; RM 7.9-7.1 (both banks)	S 9: $700-$1,000/lineal foot	.7 miles = 3,696 lineal feet	$2,587,200	$3,696,000	$4,435,200	GRFCZD: $1,500 per lineal foot for levee setback.

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
DUW-6	**S. 115th St. Bank Restoration and Revetment Setback:** Reshape and revegetate river bank, set back revetment, add large woody debris, revegetate; RM 7.2-6.9 (right bank)	S 9: $700-$1,000/lineal foot	.3 RM = 1584 lineal feet	$1,108,800	$1,584,000	$2,376,000	Highest cost based on GRFCZD $1,500/lineal foot
DUW-7	**Shallow Water Habitat Creation (20 Acres):** Create minimum 20 acres off-channel shallow habitat; RM 7.0-5.5						
DUW-7 A	Acquisition	A12: $400-$731K/acre	23 acres	$9,200,000	$12,650,000	$16,813,000	
DUW-7 B	Off-Channel area	E5: $250-$450K/acre	20 acres	$5,000,000	$7,000,000	$9,000,000	
DUW-8	**Riverton Creek Habitat Improvement:** Rehabilitate habitat, improve connection to Duwamish River for fish access and off-channel rearing/refuge habitat; RM 6.6	$257,000; ERS		$257,000	$275,000	$294,000	ERS Project construction cost + 13%
DUW-9	**Bank restoration and revetment Setback:** Setback and restore river bank, revegetate; RM 6.6-5.5						Includes acquisition of 25 acre; 20 acres restored
DUW-9 A	Acquisition of easement	A 19: $300,000-$600,000/acre	3.3 acres acquired	$990,000	$1,320,000	$1,650,000	5,808 lineal feet with 25' buffer
DUW-9 B	Revegetation of LB; RM 6.6-5.5	R3: $20-$30K/ acre		$66,000	$82,500	$99,000	
DUW-10	**Shallow Water Habitat at North Wind's Weir:** Create 2 acres of off-channel shallow water habitat; RM 6.3, RB		2.6 acres	$1,790,000	$1,915,300	$2,049,000	$1,790,000 = current cost projection
DUW-11	**Shallow Water Habitat Creation (10 Acres):** Create a minimum of 10 acres of new off-channel, shallow water/marsh habitat. It may be necessary to conduct in phases at multiple locations; a possible site may be Hamm Creek/City Light North property; RM 5.5-4.7 (both banks)						
DUW-11 A	Acquisition	A 17: $600K-$1,200,000/acre	15 acres	$9,000,000	$13,500,000	$18,000,000	

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
DUW-11 B	Shallow habitat	E 9: $800,000-$2,500,000/ acre	10 acres	$8,000,000	$16,000,000	$25,000,000	
DUW-12	**South Park Bank Restoration and Shallow Water Habitat Creation:** Rehabilitate shallow water habitats; revegetate; RM 3.8-3.7 (left bank)	S 9: $700-$1,000/lineal foot	.10 RM = 528 lineal ft	$1,576,129	$1,654,935	$1,737,682	
DUW-13	**Kellogg Island Rehabilitation:** Excavate to create shallow water habitat, revegetate; RM 1.4-1.2	E 9: $800,000-$2,500,000	1 acre	$2,589,744	$5,179,488	$7,709,232	Calc. based on 3 sites each = to SAM Olympic Sculpture Garden; If Kellogg Island = 4 acres, restoration of 1 acre total in 2-3 areas.
13 Projects	**Total Estimated Subwatershed Costs**			**$54,512,873**	**$87,876,223**	**$111,423,114**	
Marine Nearshore Subwatershed							
NS-1	**Pier 90 Shallow Water Habitat:** Protect and expand area of shallow water habitat; remove riprap, create shallow water habitat, revegetate; Seattle	E 6: $300-$800K/acre	7.5 acres	$2,250,000	$4,125,000	$6,000,000	
NS-1 A	Relocate road						Costs not available
NS-2	**Myrtle Edwards Park Small Pocket Beaches/Shallow Water Habitat:** Create several pocket beaches in Myrtle Edwards Park and north; remove riprap armoring, regrade slopes, add fishmix sediments, plant with native vegetation	SAM costs	3 projects similar to Olympic Sculpture Garden	$7,769,232	$8,313,000	$8,894,994	
NS-3	**Olympic Sculpture Park Tidal Embayment/Shallow Water Habitat Rehabilitation:** Create 0.64 acre tidal embayment and 800'x15' shallow bench; Seattle	SAM costs		$2,589,744	$2,771,026	$2,964,998	Info from SRFB application
NS-4	**Seattle Waterfront Shallow Water Bench Habitat Rehabilitation:** Create shallow habitat benches and fish friendly structures	3 locations	20x1000' = 20,000'	$7,769,232	$8,157,693	$8,565,578	Innovative feature without information - base on SAM costs

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
	along Elliott Bay; Seattle						
NS-5	**Burien Seahurst Park Shoreline Restoration, Phase 2:** Remove along approx. 3,000 feet of shoreline, restore natural beach slope, revegetate; Burien	Burien costs	$1,442/ lineal foot	$5,307,710	$5,573,095	$5,851,750	Info from Burien
NS-6	**Skeeter Creek Estuary Restoration on Vashon Island:** Restore mouth of Skeeter Creek by removing 15' bulkhead and restore natural beach profile; relocate driveway; purchase of land may be needed						
NS-6 A	Remove bulkhead	$1,500/ lineal foot	50 feet	$75,000	$80,250	$85,880	
NS-6 B	Acquisition	A6:$60,000-$300,000/ acre	.5 acre	$30,000	$90,000	$150,000	
NS-7	**Cove Creek Estuary Restoration on Vashon Island:** Replace existing culvert with box culvert, move road back from shoreline or build new road crossing; remove bulkhead; plant with riparian and marsh vegetation						
NS-7 A	Replace culvert	C4: $140-240K	1 culvert	$140,000	$190,000	$240,000	
NS-7 B	Move road						Costs not available
NS-7 C	Remove bulkhead	N6: $300-$1,000-/lineal foot	150 feet	$45,000	$97,500	$150,000	
NS-8	**Dillworth and Gorsuch Creeks Pocket Estuaries Restoration on Vashon Island:** Restore adjacent creek estuaries and lower 150 feet of channel; remove bulkhead if possible; acquisition may be necessary						
NS-8 A	Restore estuaries	E5: $150-$450K/acre	7 acres	$1,050,000	$2,100,000	$3,150,000	
NS-8 B	Remove bulkhead	N6: $300-	150'	$45,000	$97,500	$150,000	

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
		$1,000-/lineal foot					
NS-8 C	Acquisition	A6:$60,000-$300,000/ acre	15 acres	$900,000	$2,700,000	$4,500,000	
NS-9	**Mileta, Ellisport, Camp Sealth, Bates, and Tsugwalla Creeks Fish Passage Improvements on Vashon Island:** Restore fish passage to streams by replacing culverts; Vashon/Maury Island	$100,000-$200,000 per creek	5 creeks	$500,000	$750,000	$1,000,000	
NS-10	**Protect and Restore Saltmarsh at Mouth of Ellis Creek:** Acquire and protect salt marsh, restore mouth of Ellis Creek by removing dirt road, replace culverts; Vashon Island						
NS-10 A	Acquisition	A6:$60,000-$300,000/ acre	3 acres	$180,000	$210,000	$280,000	
NS-10 B	Estuary restoration	E2: $40,000 -$60,000/ acre	0.8 acres	$32,000	$40,000	$48,000	
NS-10 C	Culvert replacement	$50,000-$100,000	0.22 acre	$11,000	$15,400	$19,800	
NS-11	**Feeder Bluff Protection and Restoration in Normandy Park:** Acquire 27 parcels with 1000' feeder bluff; remove bulkhead; Normandy Park						
NS-11 A	Acquisition	A5: $24,000-$60,000/acre	13.5 acres	$324,000	$540,000	$675,000	
NS-11 B	Remove bulkhead, restore shoreline	N6: $300-$1,000-/lineal foot	1000'	$300,000	$750,000	$1,000,000	
NS-12	**Restore Pocket Estuary at Mouth of Unnamed Creek in Normandy Park**: Acquire 2 parcels with houses, remove houses and bulkheads; regrade and revegetate slope; Normandy Park						

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
NS-12 A	Acquisition						High end residential property - costs not available
NS-12 B	Remove bulkheads, restore shoreline	N6: $300-$1,000 /lineal foot	2000'	$600,000	$1,500,000	$2,000,000	
NS-12 C	Remove houses						Costs not available
NS-13	**Massey Creek Pocket Estuary Restoration in Des Moines:** Remove 300 feet of rock lined creek bank (150') and 150' jetty; restore natural creek banks; revegetate with upland and marsh vegetation						
NS-13 A	Restore stream estuary	E6: $300-$800K/acre	1 acre	$300,000	$550,000	$800,000	
NS-13 B	Remove jetty	N6: $300-$1,000/lineal foot	150'	$45,000	$112,500	$150,000	
NS-14	**Evaluate How to Improve Habitat Value of Raab's Lagoon/Pocket Estuary:** Determine how to improve Creek mouth, estuarine salt marsh and nearshore habitat; remove weir, revegetate; Maury Island						Costs not available; study needs to be completed as first phase.
NS-15	**McSorely Creek Estuary Restoration in Des Moines**: Remove rock armoring 150' upstream of mouth; remove 150' armoring along southern marine shoreline; revegetate						
NS-15 A	Restore creek channel/estuary	E5: $150-$450K/acre	1 acre	$150,000	$300,000	$450,000	
NS-15 B	Restore shoreline	N6: $300-$1,000/lineal foot	150'	$45,000	$112,500	$150,000	
NS-16	**Dash Point State Park Pocket Estuary Restoration in Federal Way:** Remove bank armoring 200' upstream on both banks; evaluate armoring of additional 50' adjacent to building						
NS-16 A	Restore creek channel/estuary	E5: $150-$450K/acre	2 acres	$300,000	$600,000	$900,000	

Project Code	Project Name, Description and Location	Unit Costs *	# of Units	Low Cost	Med.Cost	High Cost	Factors Influencing Costs
NS-16 B	Evaluate armoring/building						Costs not available
NS-17	**Functioning Nearshore Habitat Protection on Vashon/Maury Island:** Protect approximately 50 parcels on shoreline locations			$11,364,000	$11,932,200	$12,528,810	
NS-18	**Sandford Point Feeder Bluff Restoration on Vashon Island:** Remove derelict creosote pile bulkhead north of Sandford Point	N6: $300-$1,000/lineal foot	300 lineal feet	$90,000	$195,000	$300,000	Information limited
NS-19	**Tramp Harbor Intertidal Fill Removal on Vashon Island:** Remove large intertidal fill near public dock adjacent to King County road						
NS-19 A	Remove creosote bulkhead, regrade	N6: $300-$1,000/lineal foot	300 lineal feet	$90,000	$195,000	$300,000	
NS-19 B	Protect roadway behind bulkhead						Information not available
NS-20	**Maury Island Fill Removal:** Remove intertidal fill area	N6: $300-$1,000/lineal foot	150 lineal feet	$45,000	$97,500	$150,000	Information limited
NS-21	**Sandy Beach Fill and Derelict Pier Removal on Vashon Island:** Remove Intertidal fill and derelict dock south of Sandy Beach neighborhood	N6: $300-$1,000/lineal foot	275 lineal feet	$82,500	$180,000	$275,000	Information limited
21 Projects	**Total Estimated Subwatershed Costs**			**$42,429,418**	**$52,375,164**	**$61,729,810**	
77 Projects	**Total Estimated Costs - All Subwatersheds**			**$272,406,602**	**$329,355,127**	**$388,731,056**	

J. FUTURE STUDIES

Numerous data gaps in our understanding of salmon, habitat and functional linkages between habitat and salmon response remain in WRIA 9. While research and studies covered in the Strategic Assessment have significantly advanced our knowledge, they have also raised new questions. The following is a list of possible studies that have emerged from work over the past several years that might be carried out over the first 10 years of plan information. The sources of these recommendations include the following:

(1) Juvenile salmonid studies (Nelson et al. 2004; Brennan et al. 2004);
(2) WRIA 9 Chinook Salmon Research Framework
(3) Middle Green River Flow Investigation
(4) WRIA 9 Steering Committee
(5) Miscellaneous Studies

J.1 JUVENILE SALMONID STUDIES

The following is a subset of studies proposed by Nelson et al. (2004) and Brennan et al. (2004). It is expected that there are other potential studies that will be added to this list based on other efforts between the draft and final plan.

Freshwater and Estuarine Studies (Modified fry Nelson et al. 2004) [Note: some components of these studies are being carried out in a 2005 study of the transition zone]:

- Define the upstream and downstream boundaries of the current transition zone. In 2002 and 2003, high concentrations of Chinook salmon were found at the RM 6.5 and 5.5 sampling sites, but not at the next sites upstream (RM 13), or downstream (RM 1). The physical limits of the transition zone probably extend beyond the current definition of this area, and better defining the exact boundaries and the physical, chemical and biological characteristics would help direct future restoration and enhancement efforts, and protect the salmon that currently depend on it for acclimation to marine conditions.

- Link juvenile life-history trajectories and the habitats they use to their contribution to adult returns. Currently, otolith and scale studies are the best methods for tracking relationships between habitat utilization and flow parameters and their effects on juvenile to adult survival. Thus, otolith and scale collection should continue on a yearly basis to help track annual variability in these factors.

- Estimate the duration of Chinook fry residence in the Duwamish transition zone and estuary more precisely to assess the relationship between estuarine habitat utilization and fish survival. This could be tracked by studying fish otoliths, and/or mark-recapture studies using dye, fin clips or tags in order to estimate the duration of transition zone and estuary use.

- Collect additional information to verify the existence, behavior, and patterns of habitat use of natural yearling Chinook salmon. These yearlings could prove to be an important component in securing the genetic variability, life history diversity, as well as overall viability of the Green River Chinook salmon stock.

- Identify the habitat locations in the Lower Green River that potentially play an important role in Chinook salmon survival under various flow conditions. The locations of suitable rearing habitat between RM 34.5 and 13, where juvenile salmonids concentrate (i.e., rearing core areas)–at least during moderate flow years–are not known at present. Identifying these areas, if they exist, would greatly assist in protection and restoration efforts. Exploration of additional fish monitoring sites using snorkel surveys, hydroacoustics, or other suitable fish observation methods will help map and protect such core rearing habitat, as well as inform efforts to restore habitat in the Lower Green River.

- Carry out and support studies that focus on managing river flows for fish survival and habitat recovery. Flows appear to be an important factor in shaping annual behavior patterns of juvenile Chinook. Hydraulic analysis should be coupled with analysis of flows in order to determine whether certain structural attributes of the Lower Green River channel can be modified to provide surrogate low velocity conditions within constraints imposed by flood hazard reduction mandates.

- Future studies examining salmonid outmigration in the Lower Green River should use a screw trap to maximize information. Seining in the Lower River was not a completely reliable method for monitoring fish habitat utilization because the only feasible seining location in the lower ten miles of the Lower Green River was at RM 13. Moreover, the river seine method was not effective when flows exceeded 2,500 cubic feet per second (cfs) due to the beach becoming inundated and when flows were less than 300 cfs, because the river was not navigable under low flows. When placed at RM 18, the screw trap proved to be a much more effective method to monitor Chinook salmon outmigration in the Lower Green river. The trap sampled fish nearly continuously during a wide range of discharges, stage levels, and velocities. The trap was able to capture more salmonids over a greater range of sizes than the river seine. Investigators contemplating conducting future Green/Duwamish River juvenile Chinook salmon production studies should consider the use of a screw trap at this location in the Lower Green River.

- Continue monitoring juvenile Chinook salmon outmigrants on an annual basis. Due to interannual variability shown by this study, and a number of factors that affect juvenile Chinook salmon growth, behavior and habitat utilization, annual monitoring is recommended. With the additional data, patterns of behavior can be discerned and more definitively related to changing physical parameters such as flow, temperature, and habitat availability. This is especially true when evaluating findings with important economic and management implications such as the impact of hatchery Chinook salmon upon natural Chinook salmon growth in the transition zone and estuary.

- When using fork length measurements to assess growth of salmon, it is recommended that sampling should occur at least on a weekly basis to account for rapid growth rate changes in response to competition and other factors.

Marine Nearshore Studies (modified from Brennan et al. 2004):

- Larger scale (both temporal and spatial) sampling is needed to understand onshore, offshore, and cross-Sound distribution patterns. Multiple sampling methods will be required to capture patterns in horizontal, vertical, tidal, and temporal (day and night) distributions, as well as various habitat types. In addition, more information is needed about the physical forces (e.g. winds and currents) and shoreline geomorphology that may play a role in the timing, distribution, and abundance of salmon in the nearshore. More information about marine nearshore carrying capacity, competitive interactions, and prey ecology is also necessary. In light of these needs, the following recommendations for future study and additional analyses are made.

- Evaluate hatchery practices to examine potential competitive interactions with wild fish. The carrying capacity of Puget Sound or the WRIA 9 marine nearshore may or may not be able to support the number of smolts being produced by Puget Sound hatcheries along with wild production. The wild juvenile Chinook that enter the Puget Sound are vastly outnumbered by hatchery Chinook and other hatchery salmonids. Considering the similar timing, distribution, and feeding patterns, it is likely that negative competitive interactions might occur, especially in areas where food is limited.

- Conduct a combined prey availability/prey selectivity study for juvenile Chinook salmon in the shallow nearshore areas. While this study was able to quantify Chinook diets, no attempt was made to quantify prey availability and little is known about prey habitats. It is possible that Chinook are opportunistic feeders, eating whatever is the most abundant/available.

- Conduct a study to determine the source and the ecology of terrestrial insects and other prey found in the Chinook diets. The source of insects is likely from MRV, but production levels, role of proximity, and importance of vegetation composition/structure are all unknown at present. Large wood and beach wrack deposits on beaches may also play an important role in prey production. Currently little is known about the ecology of terrestrial prey items or marine prey organisms.

- Identify and quantify the factors that influence distribution patterns of juvenile salmon and their prey. Little is known about what drives juvenile salmon to be shoreline oriented, and/or distributed broadly across/throughout Puget Sound. Some indicators suggest physical forces (e.g., surface or tidal currents, wind) play a role, but these are poorly studied. Biological factors (e.g., volitional/innate migration, prey abundance/availability, predator avoidance) may also play a role, or it may be a combination of multiple factors. Additionally, offshore and day/night sampling are also needed to learn more about diel behaviors and use of various depths by different size classes of salmon.

- Conduct a study of subyearling Chinook smolts movement in the Duwamish estuary. As noted previously, it appears that Chinook migration appears to be both active and passive. A detailed migration study would allow a look at how long juvenile Chinook spend in different parts of the Duwamish estuary and open shorelines. It could also help elucidate how, when and where juvenile Chinook migrate across the open waters of Puget Sound in

order to get to Vashon and Maury Islands, or move offshore at larger sizes. This would increase the understanding of what processes drive Chinook migration.

- Conduct studies on marine forage fishes to learn more about their biology and population dynamics. Although limited surveys of spawning areas have been conducted, little is known about the biology, population dynamics, and stock status of surf smelt and sand lance. These species are critical components of marine nearshore ecosystems and serve as important prey for salmonids (at all life stages) and other marine organisms.

- Undertake a multivariate analysis of the diet data along with environmental data to further elucidate site-related diet differences. Few consistent differences were seen in Chinook prey between the site groups. One exception was that the fish from a northern group of sites consumed fewer polychaete worms and more terrestrial insects than at the other two site groups. The reasons for this are unknown, but a multivariate analysis of the diet data along with a better understanding of the distribution of prey taxa could further elucidate these and other site-related differences.

- Run additional analyses on diet data. While data qualitatively suggests that the diets of hatchery and wild Chinook overlap, it would be more powerful to quantify the amount of overlap of specific prey groups.

- Explore the relationship between adipose fin clipping of juvenile salmonids and survival. Almost 60% of the coded wire tag (CWT) Chinook examined in this study were not adipose fin clipped, even though the percentage of nonclipped CWT Chinook released throughout Puget Sound is approximately 40% (RMIS database). (Note: This pattern may be influenced by bad clipping rates, which reinforces the management recommendation to make a greater effort to clip all hatchery Chinook and coho).

- Conduct long-term and larger scale ecological monitoring of juvenile salmon throughout Puget Sound. The types of studies being conducted in the Skagit system (Beamer et al. 2004) serve as an example of what is needed throughout Puget Sound. Using multiple gear types in various habitats and environmental conditions is critical for understanding the relationships between habitat use, marine growth, year class strength, and marine carrying capacity (Orsi et al. 2000).

J.2 WRIA 9 CHINOOK SALMON RESEARCH FRAMEWORK

The following excerpts were taken from Ruggerone et al. (2004) indicating possible and priority research hypotheses or studies from the research framework. More detail on the hypotheses and planning level scopes for the studies (including study questions, sampling area, methods, sample timing, effort and confidence, and rough costs) are contained in Ruggerone et al. (2004).

Based on the conceptual model of the research framework, a number of hypotheses were developed for areas that lacked adequate information to draw conclusions (e.g., types and relative abundance of juvenile life history trajectories). Those hypotheses were prioritized by a sub-committee of the WRIA 9 Technical Committee. Prioritization relied upon the extent of

existing information (i.e., where did we know some information versus none) and the usefulness of the research in advancing the effectiveness of Chinook conservation planning for WRIA 9.

Hypotheses were grouped into tiers, with tier 1 hypotheses having the highest priority and tier 3 having the lowest priority. The tiered list of hypotheses is listed below, grouped by VSP attributes (i.e., abundance, productivity, spatial structure and diversity). In some cases, hypotheses may address more than one VSP attribute. In such cases, the hypothesis is listed with the most relevant VSP attribute and a reference to other attributes is noted. Additionally, some hypotheses are rather broad and more-specific sub-hypotheses are listed under the broad hypotheses. It is important to note that the hypotheses listed below are stated as null hypotheses and that we believe that the opposite is true. Tier 1 hypotheses were used to develop planning level Research Scopes of Work, which are presented in the following section.

Priority Salmon Research Hypotheses

The following table is a summary of the priority hypotheses, sub-hypotheses and questions and their research status taken from Ruggerone et al. (2004). "Salmon" refers primarily to Chinook.

Hypothesis or Research Action	Research Status
1.1 The upper estuary (RM 5.5-7) is key rearing habitat.	Nelson et al. (2004) provides data that support this hypothesis. See 1.1a-1.1d, below.
1.1a High salmon density boundaries occur near RM 5.5-7.	See 1.1 above. More effort is needed to identify the boundaries.
1.1b Salmon diet and growth is adequate at high and low densities.	Some diet information has been collected in 2002 and 2003, but has not been analyzed to answer this question.
1.1c Habitat capacity adequately supports salmon.	Nelson et al. (2004) provides some information, as well as ongoing research on the Skagit River. However, more research is needed to evaluate this complex question.
1.1d Salmon residence time is influenced by density.	Nelson et al. 2004 and Volk and Ruggerone (2004) have some information, but this question is not specifically addressed.
1.2 Residence time in the lower Green River is affected by flow and habitat.	Observations by Nelson et al. (2004) provide some information, but a targeted experimental approach is needed to answer this hypothesis.
1.3 Identify estuarine habitats preferred by salmon.	Previous studies show there are high densities of salmon at RM 5.5-7, but habitat preferences have not been identified in the Duwamish River. Studies in other estuaries may be useful. Morley and Toft (2004) have proposed a study that would look at difference between armored/unarmored and vegetated/unvegetated shorelines.
1.4 Identify marine nearshore habitats preferred by salmon.	Studies have been proposed by King County ("Core Areas" study) and J. Toft (UW). A pilot "core area" study was undertaken by King County to examine this hypothesis and Toft et al. (2003) looked at the feasibility of various fish sampling methods in the marine nearshore.
1.5 Growth, diet, and prey resources of salmon in the lower estuary and river is adequate.	Nelson et al. (2004) and Morley and Toft (2004) provide some information on growth and prey resources, respectively. UW will be analyzing diet of Chinook and chum collected in the estuary during 2002 and 2003. Additional stomach samples collected in 2004 could be analyzed and compared with

Hypothesis or Research Action	Research Status
	invertebrate samples collected in the Duwamish as a first glance at this hypothesis.
2.1 The Green River produces multiple life history trajectories.	Nelson et al. (2004) provides some initial estimates of juvenile trajectories, however some more specific information is needed. See 2.1a and 2.1b below.
2.1a Identify life history trajectories.	Some data are available from Nelson et al. (2004), however, more research is needed for these hypotheses.
2.1b Measure survival of fry vs. fingerling migrants.	No data for the Green River.
2.2 The productivity and capacity of Green River Chinook is adequate.	Initial work was conducted by Weitkamp and Ruggerone (2000), but recent revisions of the escapement methodology indicates that the database and analysis needs to be revised.
3.1 Egg-to-fry survival is adequate.	Work by WDFW can provide information on this hypothesis. Seiler et al. (2002) provides one year of data. Three years of additional data have been collected, but need to be analyzed and reported.
3.2 Quantity of spawning habitat is adequate.	WDFW conducts annual spawner surveys, but habitat quantity has not been measured or compared to spawning numbers.
3.3 Quality of spawning habitat is adequate.	WDFW conducts annual spawner surveys, but habitat quality has not been quantified. However, gravel supplementation does occur near the Tacoma Diversion Dam.
4.1 Fry production is affected by winter flows.	WDFW fry trapping may provide insight for this hypothesis. Seiler et al. (2002) provides one year of data. Three years of additional data have been collected, but need to be analyzed and reported. These data could be used to correlate survival with flow.
4.2 Scour from high flows impacts salmon redds.	No data for Green River, but studies in other watersheds.
4.3 Chinook spawn in river thalweg resulting in greater scour of redds.	No data for Green River.

Comprehensive List of Hypotheses Prioritized by Tiers

Tier 1

Productivity

- Habitat in the lower Green River, Duwamish estuary and marine nearshore areas is adequate to support natural juvenile Chinook salmon.

  - The upper estuary (Trimaran, Turning Basin and adjacent areas) is a key rearing habitat that supports both fry and fingerling migrants with adequate habitat capacity (diversity).

  - Habitat in the lower Green River is adequate for supporting all potential Chinook life history trajectories during both high and low flow periods.

  - Juvenile Chinook salmon utilize estuarine habitat types randomly.

- Chinook salmon utilize marine nearshore habitat types randomly.

- Growth of natural juvenile Chinook salmon in the lower river, estuary and nearshore is adequate and are not influenced by releases of hatchery fish. Diet is opportunistic and adequate.

- Chinook spawning habitat is adequate in terms of quality, quantity, and spatial distribution (spatial structure).

  - Chinook egg-to-fry survival is adequate compared with that of other populations.

  - There is adequate spawning habitat to support Chinook salmon.

  - The Green River has adequate spawning quality to support Chinook salmon.

- Green River flow regime does not affect Green River juvenile Chinook survival by either 1) concentrating spawning in the thalweg and increasing risk of scour above natural levels or 2) scouring eggs or alevins from the gravel as a result of high flows during late fall through early spring.

  - Fry production is not related to winter flow patterns.

  - The depth of scour during flood events is not sufficient to disturb Chinook redds.

  - A large proportion of adult Chinook do not spawn in the thalweg of the river.

Diversity

- Life history diversity and productivity of Green/Duwamish Chinook salmon are adequate (productivity).

  - The Green River produces multiple juvenile Chinook salmon life history trajectories.

  - Productivity and capacity of natural Green River Chinook salmon are adequate and comparable to other summer/fall Chinook salmon populations.

Tier 2

Productivity

- The relative abundance of fry versus fingerling migrants originating from the middle Green River is dependent on available habitat, which is influenced by river flow, fish density, and food availability. Alternatively, the migration pattern is genetically programmed or is related to the percentage of adults spawning in the river thalweg and numbers of emerging fry that are carried downstream before reaching suitable, low velocity habitats (abundance).

- The capacity of nearshore habitats in Puget Sound (quantity and quality), including prey availability, are adequate to support both natural and hatchery Chinook salmon populations, i.e., growth, residence time, and survival are adequate.

Diversity

- River flow during late winter and early spring "pushes" fry migrants into the estuary and marine waters, whereas freshets during May and June stimulate migration of fingerling migrants (diversity).

- Residence time of fingerling migrants in the estuary is similar to that of fry migrants; it is independent of existing habitat quantity; and residence time is not affected by hatchery releases (productivity).

Tier 3

Productivity

- The Duwamish/Green River provides an adequate migration corridor for returning adult salmon, i.e., flow and temperature are adequate.

- Water temperature and adult spawn timing have not altered emergence timing.

- Water quality in the estuary is adequate to support Chinook salmon.

- Predation has little effect on Chinook survival in the river, estuary and nearshore marine areas.

- Growth of juvenile Chinook salmon in Puget Sound is not influenced by climate-induced prey availability, and competition for prey has little effect on Chinook growth and survival.

- Duwamish sediment quality does not affect juvenile salmonids.

Spatial Structure

- Migration patterns of juvenile Chinook salmon in Puget Sound are random.

Diversity

- Spawning aggregations in the present Green River watershed, including spatially and temporally segregated stocks and the hatchery stock, are genetically similar. Migration timing of spawning aggregations is similar (spatial structure).

J.3 MIDDLE GREEN RIVER FLOW INVESTIGATION

The Middle Green Flow Investigation is a collaborative effort to identify flow-related research priorities for the middle reach of the Green River and develop a program to implement studies to

address the priorities. This is a joint effort involving staff from King County, US Army Corps of Engineers, USGS, American Rivers, WDFW, and WDOE. The current and upcoming work is focusing on enhancing our understanding of the relationship between river flow patterns, physical responses, and biological parameters. Three draft "themes" have been proposed for consideration as part of the investigation.

- Theme 1: A retrospective study of the Green River comparing channel conditions prior to and after construction of HHD

- Theme 2: Macrohabitat analysis and high flow connectivity that includes describing, mapping and summarizing off-channel habitat conditions for high flows

- Theme 3: The influence of physical processes on aquatic and riparian habitat

All three of these studies have potential to contribute substantial information to flow-habitat relationships in the Middle Green River that will aid in salmon conservation and recovery.

Theme 1 is the first priority and more detailed scoping has been initiated. The key hypothesis is that closure and operation of Howard Hanson Dam and the modifications in channel structure (e.g., construction of levees and revetments, channel straightening and dredging) for flood control purposes have altered the rates, magnitudes and spatial arrangement of ecosystem processes and functions compared to the pre-dam state. The information we learn from addressing this hypothesis will be used to address a follow-up hypothesis: the flow regime during the post-dam period causes geomorphic and habitat variability (in functional, structural and process attributes) sufficient to sustain a viable salmonid population.

The study encompasses the river and its valley from the upper limits of the Green River at approximately river mile 88, downstream to the historic confluence with the now-diverted White River at approximately river mile 31. The time frame covered by this study varies, but generally covers the period from approximately 1856 to the present day. Certain attributes will be examined for a more limited study period from 1936 to present (e.g., hydrologic/gauging data, photographic record), while other attributes may go back to 1856 (e.g., written accounts, anecdotal information).

Theme 2 Hypothesis: Scheduled releases of high flow and selected habitat improvement projects will increase the area and complexity of off-channel habitat for fish in the Middle Reach of the Green River. An increase in habitat area will depend on river stage, secondary channel density, and width of channel migration zone. An increase in usable habitat area will depend on timing of releases and concurrent life stage of fish species.

Study Design and Objectives: Flood storage behind Howard Hanson Dam has reduced high flows downstream. Flows in the Middle Reach of the Green River have not exceeded 12,000 cfs since 1962. Pre-regulation high flows ranged from 12,000 cfs (.50 probability), to 21,000 cfs (.10 probability), to 34,000 cfs (.01 probability) (King County, 1993). Flood storage has altered the hydrologic regime of the river and reduced the extent of overbank flows (connectivity) in floodplain and other off-channel areas.

The overall study design is to describe, map, and summarize off-channel habitat conditions at specified high flows on the Middle Reach of the Green River in King County, WA. Habitat

assessment areas will include the floodplain at specified flows, historic channel locations, channel migration hazard areas, secondary channels, and associated landforms outside the main channel of the river. Objectives of the study are to define and quantify potential fish habitat benefits of restoring flows greater than 12,000 cfs with overflows in off-channel areas on the river.

Theme 3 involves the investigation of physical processes on aquatic habitat at the scale of channel forms (e.g., pools, riffles, runs). The results will be used to develop an understanding of how habitat conditions for these general types of channel forms will respond to human manipulations of streamflow, sediment load, channel morphology, and riparian vegetation. Hypothesis: High flows can be managed to allow ecological functions (e.g., creating and maintaining off-channel habitat, recruitment of large woody debris, path turnover) without negative consequences including redd scour, depletion of limited sediment supply below Howard Hansen dam, and reducing large woody debris and instream habitat structure. There are a number of important secondary hypothesis related to specific habitat responses. For example, the probability of Chinook salmon redd scour increases with streamflow but can be reduced by limiting the frequency and duration of flows exceeding some threshold and managing flows when salmon are selecting spawning sites.

Study Design and Objectives: This study will examine the interactions between streamflow, sediment, and large woody debris (LWD) in the middle Green River. It will require information about channel form and hydraulic conditions at representative sites within the Middle Green River. Hydraulic and sedimentological conditions would be analyzed at the sites to characterize sediment transport regime (e.g., threshold of motion, partial transport, equal mobility of all particles). The sediment transport investigation would include experiments using tracer cobbles in Chinook salmon redd/non-redd locations to assess scour during winter. The investigation of LWD would include a retrospective assessment of in-channel LWD identified from historical aerial photos, US Army Corps of Engineers data on new wood placement, and multispectral aerial imaging. Remote inventorying would be verified and supplemented by field surveys of the location (relative elevation and location in channel) of selected pieces of LWD. The LWD investigation would quantify LWD retention time in selected reaches; quantify streamflow levels for distinct types of interactions (e.g., streamflow that transport key pieces for log jams, transport smaller debris, transport sediment around LWD; or provides cover or pools adjacent to LWD).

J.4 Predation

Conduct a study of the impacts of predation on Chinook salmon and other salmonids (by birds, marine mammals or other fish) and examine actions that can be taken to reduce those impacts. Study efforts should take advantage of and be coordinated with predation studies elsewhere in Puget Sound. The study could be a component of project monitoring and developed in detail as part of future habitat plan implementation.

J.5 Miscellaneous Studies

1. Conduct a study to evaluate the feasibility of reconfiguring the Black River pump station to improve fish passage and allow gravity flow under non-flooding conditions, while maintaining or improving the existing flood control function of the pump station.

2. Evaluate Propeller Scour/Boat Wakes on Habitat Projects – Determine whether propeller scour and boat wakes damage existing habitat or constrain future habitat in the Duwamish River. Prop scour from tugboats and other marine vessels and boat wakes may damage restored habitats, limiting where they can be placed. Being aware of this will aid in site selection and project design. Study design should include evaluation of impacts of prop scour on capped contaminated sediments. If prop scour/boat wakes is determined to be a significant detrimental factor for habitat projects, determine what can be done to: (1) reduce wakes/scour and/or (2) reduce the impact through structural solutions.

3. Evaluate Economic Impact of Restoration – Evaluate the economic impacts of purchase by governments of Duwamish lands for large habitat rehabilitation/substitution projects. This would include examination of impacts on economic activity and government revenues from the removal of land from the industrial base for use in habitat restoration. This evaluation could be expanded to examine all the benefits and all the costs associated with land acquisition for habitat restoration.

4. Extend Chinook Salmonid Research Program to Upper Green – Extend the salmonid research program developed for the lower four subwatersheds (Ruggerone et al. 2004) to the Upper Green River subwatershed. Using the WRIA 9 Chinook Salmon Research Framework as a basis, develop hypotheses or research actions regarding habitat, fish utilization and key viable salmonid population parameter issues.

5. Study Impacts of Fish Carcasses on Water Quality – Conduct tests above the Howard Hanson Dam (HHD) to see how fish carcass distribution affects water quality. Perform water quality tests to determine whether adult fish access to habitats between the Tacoma diversion Dam and the HHD in the future would compromise drinking water quality.

6. Field Check Verification of Riparian Conditions in Upper Green - Further verify riparian conditions in the Upper Green. Although conditions have been monitored by the various public and private landowners, scientific documentation of riparian conditions is limited in the Upper Green River subwatershed. The WRIA9 Technical Committee determined that a more comprehensive verification of riparian conditions is a vital step towards prioritizing, designing, and implementing projects focused on protecting or improving riparian conditions in the subwatershed.

7. Inventory of Off-Channel Habitat in Upper Green - Create a comprehensive inventory of off-channel habitat to provide a basis for prioritization, sequencing, and implementation of projects designed to protect or restore off-channel habitat in the Upper Green subwatershed.

8. Analyze Link Between Habitat Protection and the Forest and Fish Report Provisions – Analyze the effects of current Forest & Fish initiatives on addressing habitat protection to determine if these provisions are attaining goals.

9. Develop a Culvert and Failing/High Risk Roads Inventory in Upper Green – Develop a culvert and failing/high-risk roads inventory to determine which roads and/or culverts are likely to fail, with the purpose of using this information to prioritize roads and culverts to repair or remove from the subwatershed.

10. Correlate Predicted Core Areas in Upper Green with Recent Habitat Assessment Data – An inventory sponsored by the City of Tacoma and carried out by R2 Consultants (transects in 48 locations in the Green River mainstem from the North Fork to Friday Creek to identify areas for fish habitat mitigation projects) will be complete at the end of 2005. An assessment should be carried out comparing habitat conditions to predicted core areas within the mainstem.

11. Fish Passage Barrier Studies and Future Projects in Upper Green - Inventories of fish passage barriers are incomplete in the Upper Green subwatershed. These inventories should be completed, including evaluation of barriers resulting from logging roads or railroads in order to assess which barriers should be removed based on suitability of potential habitat that would be opened to salmonid use. Barriers should then be prioritized for removal and inclusion in future updates to the Habitat Plan.

K. HABITAT PLAN RECOMMENDATIONS THAT BENEFIT BULL TROUT

In addition to addressing the habitat needs of Chinook, this Habitat Plan also provides habitat improvements for bull trout, listed by the U.S. Fish and Wildlife Service as threatened in November 1999. The ecosystem approach – with a focus on habitats and the processes that create those habitats – is intended to benefit all salmonid species.

Very little is known about bull trout presence and use of habitats in WRIA 9 but this Appendix provides a matrix showing how the recommendations in this Habitat Plan address the bull trout recovery actions listed in the U.S. Fish and Wildlife Service's Draft Recovery Plan for the Coastal-Puget Sound District Population Segment of Bull Trout (U.S. Fish and Wildlife Service 2005).

Category	Action	In WRIA 9 Salmon Habitat Plan
Identify impaired stream channel and riparian areas and implement actions to restore their appropriate functions.	Restore and protect riparian areas. Identify impaired riparian areas and restore vegetative cover to provide shade, canopy, riparian cover, and native vegetation. Develop and implement a public awareness campaign regarding the effectiveness and necessity of maintaining and improving riparian areas for supporting salmonids. Priority areas for protection include: developing rural areas within identified local populations; and foraging and migration, and overwintering areas with existing high quality habitat or habitat on a trajectory towards recovery. (p. 247, 1.3.1)	Watershed-wide education/outreach programs; Lower Green, Middle Green, and Duwamish projects. Also addressed in the Scientific Foundation chapter.
	Identify, evaluate, and restore overwintering habitat in the mainstem rivers and tributaries. Determine where overwintering habitat areas are degraded by factors such as sediment accumulation, bedload movement, or low flows in all core areas. (p.247, 1.3.2)	Upper Green program; Middle Green and Lower Green projects. Also addressed in the Scientific Foundation chapter.
	Identify and restore foraging waters with high restoration benefit. Highest priorities are mainstems downstream of local populations used by anadromous life histories to reach marine habitats. (p.248, 1.3.3)	No specific actions. Middle Green, Lower Green, and Duwamish projects apply indirectly.
	Reduce stream channel degradation and increase channel complexity. Priority areas include most lower mainstem rivers in all core areas. (p.248, 1.3.4)	Middle Green, Lower Green, and Duwamish projects. Also addressed in the Scientific Foundation chapter.
	Practice non-intrusive flood control and flood repair activities. Provide technical assistance to Counties, Cities, and private landowners to develop options for fish friendly flood control methods and repair techniques. Ensure that negative effects to bull trout habitat from ongoing flood control activities (e.g., dredging, woody debris removal, channel clearing, hardened bank stabilization, and riparian removal from dikes and levees) are avoided or minimized. Alternatives should emphasize restoration of floodplain connectivity and the elimination or setback of existing armored banks, dikes and levees to restore habitat forming processes. (p. 249, 1.3.5)	Watershed-wide programs; Middle Green, Lower Green, and Duwamish projects

Category	Action	In WRIA 9 Salmon Habitat Plan
	Reduce development impacts on streams, floodplains, and lake shores. (p. 249, 1.3.6)	Land Use policies and Watershed-wide programs. Also addressed in the Scientific Foundation chapter.
	Reduce transportation corridor impacts on streams. (p. 249, 1.3.7) Reduce impacts from the legacy of road and railroad encroachment (e.g., sedimentation, channel straightening, channel relocation, channel constriction, and undersized bridges). (p. 249, 1.3.7)	Upper Green, Middle Green, Lower Green, and Duwamish projects; Upper Green program (1). Also addressed in the Scientific Foundation chapter.
	Improve grazing practices. (p. 250, 1.3.8)	No specific actions.
	Restore natural stream channel morphology. (p. 250, 1.3.9)	Lower Green policy (1) and Upper Green program (1). Also addressed in the Scientific Foundation chapter.
	Enhance and restore instream habitat. (P. 250, 1.3.10)	Land Use policies, Watershed-wide programs, Upper Green project (1), Middle Green projects, Lower Green policy and projects, Duwamish projects. Also addressed in the Scientific Foundation chapter.
	Protect riparian and stream channel habitat at managed and unmanaged campgrounds, trail systems, and recreational sites. (p. 251, 1.3.11)	No specific actions. Regulatory policies and Watershed-wide programs apply indirectly.
Identify barriers or sites of entrainment for bull trout and implement actions to provide passage and eliminate entrainment.	Eliminate or minimize entrainment at diversions and ditches. (p. 244, 1.2.1)	Watershed-wide program, Land Use policies, and Lower Green projects.
	Provide adequate fish passage around diversions and dams. (p. 245, 1.2.2) Specifically: Howard Hansen Dam	Upper Green project (1). Also addressed in the Scientific Foundation chapter.
	Identify and eliminate culvert barriers. (p. 245, 1.2.3)	Land Use policies, Watershed-wide programs, Upper Green policies and projects, and Marine Nearshore policies and projects. Also addressed in the Scientific Foundation chapter.
	Identify and eliminate or modify tide gates, pump stations, and flood gates blocking access to bull trout habitat. (p. 246, 1.2.4)	Lower Green project. Also addressed in the Scientific Foundation chapter.
	Inform the public about the impacts of recreational barriers to migrating bull trout. (P.246, 1.2.5)	No specific actions.

Category	Action	In WRIA 9 Salmon Habitat Plan
Operate dams to minimize negative effects on bull trout in reservoirs and downstream.	Reduce reservoir operation impacts. (p.252, 1.4.1)	No specific actions. Upper Green program (1) applies indirectly. Also addressed in the Scientific Foundation chapter.
	Provide sufficient instream flow downstream from dams and diversions. (p.252, 1.4.2)	No specific actions. Addressed in the Scientific Foundation chapter.
Identify upland conditions negatively affecting bull trout habitats and implement actions to restore appropriate functions.	Update and/or review local Forest Service or other watershed analyses. (p.253, 1.5.1)	No specific actions.
	Upgrade or decommission existing and potential problem roads. (p.253, 1.5.2)	Upper Green project (1)
	Minimize levels of effective impervious surface from development. (p.254, 1.5.3) Minimize…by protecting hydrologically mature forest cover…and by implementing other low impact development measures. Alternatively, if lacking such forest condition, protect the opportunity to reestablish forest cover by minimizing amount of clearing, buildings, and infrastructure. If reestablishment of forest cover is not possible due to existing high intensity development (e.g., already built-out areas of cities and unincorporated urban growth areas), then require highest levels of stormwater engineering and integrate low impact development measures (e.g., impervious surface removal, roof top gardens) where possible. For rural areas (i.e., lands not in cities or not within unincorporated areas with existing high density development) draining to bull trout foraging, migration and overwintering areas, maintain at least (but preferably more than) 65 percent hydrologically mature forest cover and no more (and preferably much less) than 10 percent effective impervious area.	Land Use policies and Watershed-wide programs. Also addressed in the Scientific Foundation chapter.
Identify impaired estuarine and nearshore marine habitats and implement actions to restore their appropriate functions.	Identify and remediate contaminant sites in estuarine and nearshore marine areas. (p.255, 1.6.1) High priority sites include those in close proximity to known and potential marine forage fish spawning areas and bull trout subadult and adult foraging habitats. (Specifically, Lower Duwamish and Elliott Bay)	Duwamish policy (1) and projects. Also addressed in the Scientific Foundation chapter.
	Reduce impacts of development and transportation corridors along estuarine and marine shorelines. (p. 255, 1.6.2) Where feasible remove or reduce existing bank armoring (bulkheads and riprap), dikes, in-water and over-water structures (e.g., pilings, docks) to restore or enhance altered shorelines and adjacent riparian areas. Avoid further development that will interfere with natural bluff and beach erosion processes, degrade vegetated intertidal habitats and forage fish spawning areas, or degrade nearshore riparian areas. Highest priority areas for restoration include those in or in close proximity to known and potential marine forage fish spawning areas and bull trout subadult and adult foraging habitats, especially those directly linked to known core areas.	Land Use policies, Duwamish projects, Marine Nearshore programs and projects. Also addressed in the Scientific Foundation chapter.
	Restore or recreate intertidal foraging habitats in key areas. (p.256, 1.6.3). Specifically Shilshole Bay and Elliott Bay.	No specific actions. Marine Nearshore projects apply indirectly.
Conduct evaluations of the adequacy and effectiveness of current and past best management practices in maintaining or achieving	Conduct evaluations of the adequacy and effectiveness of current and past best management practices in maintaining or achieving conditions conducive to bull trout recovery. (p. 268, 5.3.1)	No specific actions.
	Develop a temperature monitoring program. (p. 268, 5.3.2)	No specific actions. Addressed in Adaptive Management and Monitoring chapter.
	Evaluate and improve existing forestry best management practices. (p.269, 5.3.3)	No specific actions.

Category	Action	In WRIA 9 Salmon Habitat Plan
conditions conducive to bull trout recovery.	Evaluate and improve existing agricultural conservation practices. (p.269, 5.3.4) Provide farmers with information about the functions and importance of functional riparian areas, and develop incentives for improving riparian conditions in agricultural settings.	Land Use policies, Watershed-wide programs, Middle Green program, Also addressed in the Scientific Foundation and Implementation chapters.
	Evaluate and improve existing and proposed development best management practices. (p.269, 5.3.5)	Land Use and regulatory policies, Watershed-wide programs, and a Lower Green policy. Also addressed in the Scientific Foundation chapter.
Maintain or improve water quality in bull trout core areas or potential core habitat.	Identify and improve or remove unstable or problem roads causing sediment delivery. (P. 238, 1.1.1)	Upper Green project.
	Improve routine road maintenance practices affecting water quality. (p.239, 1.1.2)	Programmatic support policy, Upper Green policy,
	Implement measures to restore natural thermal regime. (p. 240, 1.1.3). Use Water Resource Inventory Area's habitat limiting factors analyses, Washington Department of Ecology's 303(d) lists, and Water Resource Inventory Area's Ecosystem Diagnostic Treatment modeling to help prioritize areas. (Specifically: Lower Green River foraging migration and overwintering habitat)	Land Use policy. Also addressed in the Scientific Foundation chapter.
	Reduce anthropogenic nutrient input. (p. 240, 1.1.4) by improving sewage treatment and disposal, agriculture practices (e.g., manure spreading, fertilizing), and silvicultural fertilizing practices.	Land Use policies, Watershed-wide programs, Middle Green program, and a Marine Nearshore program. Also addressed in the Adaptive Management and Monitoring chapters. Silvicultural fertilizing practices are not addressed.
	Encourage the uptake of marine-derived nutrients from salmon carcasses into the freshwater ecosystem. (p. 241, 1.1.5) This is facilitated by two processes: 1) the hauling of carcasses up into the riparian zone by animals (mammals and birds), and 2) the reestablishment of complex stream channels (braided channels or side channels, large woody debris incorporated into the channel structure, etc.) to trap and retain the carcasses. Explore the potential to modify salmon harvest management (see action 3.1.3) to assure a more consistent and large spawning escapement of salmon to all core areas with anadromous bull trout populations, especially pink and chum salmon which seem to provide the largest benefit to char. Also conduct hatchery salmon carcass deployment efforts where appropriate.	No specific actions.
	Monitor water quality and meet water quality standards for temperature, nutrient loading, dissolved oxygen, and contaminants. (p. 241, 1.1.6)	No specific actions. Addressed in the Scientific Foundation and Adaptive Management and Monitoring chapters.

Category	Action	In WRIA 9 Salmon Habitat Plan
	Identify, restore, and protect groundwater and hyporheic sources. (p. 242, 1.1.7) protect identified refugia areas from ground or surface water withdrawals, and prioritize these areas for instream habitat improvements. (Specifically: Lower Green River foraging migration and overwintering habitat)	Land Use policies, Watershed-wide programs, and Middle Green projects. Also addressed in the Scientific Foundation chapter.
	Reduce anthropogenic sediment and contaminant sources generated from agriculture practices. (p. 242, 1.1.8) Identify and reduce fine sediment and contaminant sources (pesticides) from agriculture practices in watersheds of the Puget Sound Management Unit. Highest priority areas include where agriculture exists above or adjacent to spawning and juvenile rearing habitats within core areas. Secondary priorities include mainstems and associated tributaries that provide foraging, migration, and postdispersal rearing.	Land Use policies, Watershed-wide programs, and a Middle Green program. Also addressed in the Scientific Foundation chapter.
	Reduce anthropogenic sediment sources generated from forest management. (p. 243, 1.1.9)	Upper Green policies. Also addressed in the Habitat Management Strategies chapter.
	Reduce anthropogenic sediment and contaminant sources generated from residential development and urbanization.	Land Use and Programmatic support policies, and Watershed-wide programs.
	Maintain and improve instream flows. (p. 244, 1.1.11) Locate and terminate unpermitted water withdrawals to restore adequate instream flows and prevent potential entrainment of juvenile bull trout. Increase compliance monitoring and enforcement of unauthorized withdrawals and enforcement action. Identify stream reaches where decreased instream flows limit bull trout spawning, rearing, foraging, migration, or overwintering and work to improve instream flows to more fully support these uses. Long-term efforts must included addressing overallocated basins or tributaries through water conservation, voluntary purchase or retirement of water rights, education, incentives, and enforcement.	Land Use and Regulatory policies, a Watershed-wide program. Also addressed in the Scientific Foundation chapter.
Use existing Federal authorities to conserve and restore bull trout.	Ensure adequate protection for bull trout at all life stages under Washington State Water Quality Standards. (p.272, 6.2.1)	No specific actions. Addressed in the Scientific Foundation chapter.
Use partnerships and collaborative processes to protect, maintain, and restore functioning core areas for bull trout.	Coordinate bull trout recovery with other listed salmonid species recovery efforts. (p.271, 6.1.1)	Programmatic support policy, Upper Green and Lower Green projects. Addressed in Executive Summary, Scientific Foundation, and Adaptive Management and Monitoring, and Implementation chapters.

Category	Action	In WRIA 9 Salmon Habitat Plan
	Ensure protection of the highest quality spawning and rearing habitats remaining within each core area through measures including conservation land purchases and easements. (p.271, 6.1.2)	Land Use policies, Watershed-wide programs, Upper Green, Middle Green, Lower Green, Duwamish, and Marine Nearshore projects. Also addressed in the Adaptive Management and Monitoring chapter.
Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats.	Design and implement a population monitoring strategy for the Puget Sound Management Unit. Add a monitoring component for foraging, migration, and overwintering habitats (e.g., lower Green River, lower Nisqually River) that are identified as essential for recovery. (p.265, 5.1.1)	No specific actions. Addressed in the Adaptive Management and Monitoring chapter.
	Evaluate existing recovery measures over time. (p.265, 5.1.2)	No specific actions. Addressed in the Adaptive Management and Monitoring chapter.
Implement research and monitoring studies to improve information concerning the distribution and status of bull trout.	Develop a predictive model of suitable habitat used by juvenile and resident bull trout. (p.270, 5.5.1)	No specific actions. Bull trout utilization of habitat is addressed in the Scientific Foundation and Adaptive Management and Monitoring chapters.
	Investigate potential use of the upper Green River by bull trout, and investigate habitat suitability. (p.270, 5.5.2) Conduct additional surveys to determine presence of remnant bull trout population in the upper Green River basin. Evaluate habitat suitability in the upper Green River for expanding current foraging, migration, and overwintering habitat, and evaluate habitat suitability for spawning and rearing in the upper Green River basin for possible establishment of an additional core area. (p.270, 5.5.2)	No specific actions. Addressed in the Scientific Foundation and Adaptive Management and Monitoring chapters.
	Investigate potential use of the upper Nisqually River by bull trout. (p.271, 5.5.3)	n/a
Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery actions.	Determine complete distribution of anadromous, fluvial, adfluvial, and resident bull trout and habitats used by each life stage. (p.265, 5.2.1)	No specific actions. Addressed in the Scientific Foundation and Adaptive Management and Monitoring chapters.
	Determine migratory pathways, patterns, and habitat preferences of anadromous bull trout in the Puget Sound Management Unit. (p.266, 5.2.2)	No specific actions.
	Conduct migrational studies for the Puget Sound Management Unit and coordinate with the Olympic Peninsula Management Unit and British Columbia. (p.266, 5.2.3)	No specific actions.
	Identify and assess complete estuarine and marine forage base for bull trout. (p.266, 5.2.4)	No specific actions. Addressed in the Scientific Foundation and Adaptive Management and Monitoring chapters.

Category	Action	In WRIA 9 Salmon Habitat Plan
	Determine extent of effects from contaminant exposure. (p.267, 5.2.5) Specifically Duwamish River/Elliott Bay. (p.267, 5.2.5)	No specific actions. Addressed in the Scientific Foundation and Adaptive Management and Monitoring chapters.
	Evaluate importance of streams with only incidental bull trout presence. (p.267, 5.2.6) Evaluate the importance and contribution of core area tributaries or independent streams (e.g., Whatcom Creek) directly flowing into Puget Sound currently assumed to have only limited incidental bull trout use (i.e., for foraging or refuge). Determine which of these tributaries and independent streams are most likely necessary for supporting population expansion and/or long-term persistence in core areas.	No specific actions. Addressed in the Scientific Foundation and Adaptive Management and Monitoring chapters.
	Identify key habitat features within freshwater and marine habitats. (p.267, 5.2.7) Priorities include identification of key groundwater sources, hyporheic areas, and other cold water refugia; identification of desired water temperature regimes in river and tributary reaches used for foraging and migration; and identification of key habitat features required to support bull trout in migratory corridors and overwintering areas.	No specific actions. Addressed in the Scientific Foundation and Adaptive Management and Monitoring chapters.
	Monitor additional local populations to provide more accurate abundance estimates for each core area. (p.268, 5.2.8)	No specific actions. Addressed in the Scientific Foundation and Adaptive Management and Monitoring chapters.
	Determine actions necessary to restore spawning and rearing in potential local populations. (p.268, 5.2.9)	No specific actions. Addressed in the Scientific Foundation and Adaptive Management and Monitoring chapters.
Enforce existing Federal, State, and Tribal habitat protection standards and regulations and evaluate their effectiveness for bull trout conservation	Ensure restrictions on recreational mineral prospecting and placer mining in bull trout habitat are effective. (p.272, 6.3.1) Evaluate compliance with and effectiveness of restrictions in protecting bull trout habitat as described by the State's rules and regulations for mineral prospecting and placer mining ("Gold and Fish" pamphlet; WDFW 1999).	No specific actions. One Regulatory policy applies indirectly.
Develop actions to reduce negative effects of nonnative taxa on bull trout.	Remove invasive nonnative plants that are limiting the effectiveness of riparian areas and restore with native vegetation. (p.258, 2.6.1)	Programmatic support policy, Watershed-wide program, Middle Green projects, Duwamish programs and projects. Also addressed in the Scientific Foundation and Adaptive Management and Monitoring chapters.
	Continue control of Spartina in estuarine and nearshore areas. (p.259, 2.6.2)	No specific actions.
Develop genetic management plans and guidelines for appropriate	*Transplantation and artificial propagation of bull trout is not proposed for the Puget Sound Management Unit at this time.	No specific actions. Addressed in the Scientific Foundation.

Category	Action	In WRIA 9 Salmon Habitat Plan
use of transplantation and artificial propagation.*		

Beyond WRIA 9 Jurisdictions' Scope

Category	Action	Action in WRIA 9 Draft Plan
Develop and implement State and Tribal native fish management plans integrating adaptive research.	Integrate research and monitoring results into native fish management plans and related information resources. (p.259, 3.1.1)	n/a
	Protect remaining bull trout strongholds and native species complexes. (p.259, 3.1.2) Large abundances of pink and chum salmon are of particular benefit to bull trout.	n/a
	Provide increased forage opportunities in freshwater. (p.260, 3.1.3)	n/a
	Increase biomass of marine forage base. (p.260, 3.1.4)	n/a
Incorporate conservation of genetic and phenotypic attributes of bull trout into recovery and management plans.	Develop and implement a genetics study plan for future collection and analysis of genetic samples from local populations. (p.263, 4.1.1)	n/a
	Determine level of interaction between bull trout and Dolly Varden populations. (p.263, 4.1.2)	n/a
Maintain existing opportunities for gene flow among bull trout populations.	Evaluate level of gene flow among core areas.	n/a
Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.	Determine the life history requirements and interactions of overlapping resident and migratory bull trout populations. (p.271, 5.6.1)	n/a
Convene annual meetings of each management unit recovery team to review progress on recovery plan implementation.	Generate progress reports on implementation of the bull trout recovery plan. (p.273, 7.1.1)	n/a
Develop and implement a standardized monitoring program to evaluate the	Develop and implement a standardized monitoring program to evaluate the effectiveness of recovery efforts (coordinate with recovery action 5.1). (p.273, 7.2.1)	n/a

Category	Action	Action in WRIA 9 Draft Plan
effectiveness of recovery efforts.		
Revise scope of recovery as suggested by new information.	Periodically assess progress toward recovery goals and assess recovery action priorities. Annually review progress toward population and abundance criteria and recommend changes, as needed, to the Puget Sound Management Unit recovery plan. In addition, review actions, action priorities, completed actions, budget, time frames, particular successes, and feasibility. (p.273, 7.3.1)	n/a
Implement control of nonnative fishes where found to be feasible and appropriate.	Determine distribution and abundance of nonnative fish (brook trout and westslope cutthroat trout) and identify overlap with bull trout. (p.257, 2.5.1.)	n/a
	Evaluate brook trout impacts to migratory bull trout populations. (p.258, 2.5.2)	n/a
	Experimentally remove established brook trout populations from priority streams. (p.258, 2.5.3)	n/a
Evaluate policies for preventing illegal transport and introduction of nonnative fishes.	Review existing enforcement of current policies for preventing illegal transport and introduction of nonnative fishes. (p.256, 2.2.1)	n/a
Provide information to the public about ecosystem concerns of illegal introductions of nonnative fishes.	Discourage unauthorized fish introductions. (p.257, 2.3.1)	n/a
Evaluate biological, economic, and social effects of control of nonnative fishes.	Review existing protocols for eradicating, suppressing, or managing nonnative fish populations and implement protocols where needed. (p.257, 2.4.1)	n/a
Develop, implement, and enforce public and private fish stocking policies to reduce stocking of nonnative fish that potentially affect bull trout.	Review and analyze effectiveness of current fish stocking policies. (p.256, 2.1.1)	n/a
Evaluate and prevent overharvest and incidental angling mortality of bull trout.	Evaluate the impacts of harvest on bull trout populations. (p.261, 3.2.1)	n/a
	Evaluate and minimize incidental mortality of bull trout in other fisheries. (p.261, 3.2.2)	n/a
	Increase enforcement efforts with special emphasis on bull trout spawning and staging areas to eliminate illegal harvest. (p.261, 3.2.3)	n/a
	Expand angler and public awareness efforts. (p.261, 3.2.4)	n/a
	Coordinate with British Columbia on harvest management strategies. (p.262, 3.2.5)	n/a
Evaluate potential effects of introduced fishes and associated sport fisheries on bull trout recovery and	Monitor and evaluate effects of planted hatchery fish on bull trout, especially effects related to increased competition, disease, and predation. (p.262, 3.3.1)	n/a

Category	Action	Action in WRIA 9 Draft Plan
implement actions to minimize negative effects on bull trout.		
Evaluate effects of existing and proposed fishing regulations on bull trout.	Continue to monitor and evaluate the effects of the current minimum size limit on existing recreational bull trout fisheries. (p.262, 3.4.1)	n/a
	Identify important bull trout spawning and staging areas that may require special regulations. (p.263, 3.4.2)	n/a
Evaluate effects of disease and parasites on bull trout, and develop and implement strategies to minimize negative effects.*	*Evaluating the effects of disease and parasites on bull trout is not an action proposed for the Puget Sound Management Unit at this time; (p.270, 5.4)	n/a