STATE OF WASHINGTON

GUIDANCE ON WATERSHED ASSESSMENT FOR SALMON

JOINT NATURAL RESOURCES CABINET

MAY 2001

The Joint Natural Resources Cabinet*

In May of 1997, Governor Gary Locke and agency heads signed a memorandum agreeing to establish a forum to serve as the "…forum and ongoing institutional framework to promote interagency communication, coordination and policy direction on environmental and natural resource issues."

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*In August of 1999, the Northwest Indian Fisheries Commission formally accepted the Governor's invitation to join the Joint Cabinet. They have asked Terry Williams, Executive Director of Fisheries and Natural Resources for Tulalip Tribe, to participate with the Joint Cabinet.

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Introduction

Essential to salmon recovery is the need to protect and restore the health of our watersheds. Salmon encounter many obstacles that contribute to their decline, so any salmon strategy must consider what we know and do not know about these problems; what is possible scientifically and physically; what is attainable socially; and what is sustainable for recovery in the long term. We must evaluate habitat conditions and causes of habitat losses in our watersheds, to determine what needs to be done and where.

> ***Salmon*** refers to all species of salmon, steelhead, trout, and char native to Washington.

> A ***watershed*** is the area of land that water flows across or under on its way to a river, lake, or ocean. It includes all surface fresh water and adjacent estuaries and marine areas.

> ***Conservation*** includes protecting, maintaining, and restoring habitat to support the needs of salmon.

Watershed assessment is compiling and analyzing technical information on watershed conditions compared with those needed for salmon, and the effect of human activities on those conditions. It is the first step in developing strategic conservation plans, from the perspective of making good investment decisions as well as ensuring benefits to salmon. Ultimately, strategic watershed conservation efforts will be key local building blocks for regional efforts to achieve salmon recovery.

Because data availability and technical resources vary across geographic areas, the way watershed assessment tasks are approached and the time frame for accomplishing them varies. A single assessment method or tool will likely not provide all the information needed to design habitat conservation and salmon recovery strategies. A standardized assessment framework is needed to bring together different assessment elements, improve consistency in approaches, and guide future assessment work. The ***Guidance on Watershed Assessment for Salmon*** is designed to meet this need, and to help local groups and funding entities make better decisions about their habitat conservation activities.

Why conduct a watershed assessment?

Aquatic systems are dynamic and continually modified by humans. A science-based watershed perspective analyzes the past and current state of the watershed, captures its unique physical and biological characteristics and limitations, and compares these conditions to those needed for salmon. It should explicitly identify uncertainty of information and be supported by written records that provide a basis for decision making.

Assessments help us determine how well a watershed is functioning and how it responds to natural and human disturbances. They should help us understand:

- How a watershed "works."
- How a watershed has changed as a result of human activities.
- How those changes affect salmon and their habitat today and in the future.
- What needs to be done and where to protect and/or return the habitat to a productive state for salmon..

What is the current status of watershed assessment work?

Much watershed assessment work has already been or will be performed. This includes but is not limited to Limiting Factors Analysis (LFA) under the Salmon Recovery Act, watershed assessment under the Watershed Planning Act, Salmon and Steelhead Habitat Inventory and Assessment Project (SSHIAP), Washington Department of Natural Resources (DNR) and US Forest Service (USFS) watershed analyses, and the Northwest Power Planning Council (NWPPC) sub-basin assessments for the Columbia River basin (Appendix 1). In addition, specific management guidelines are currently available (or being developed) to facilitate the consistent application of good science and management practices for salmon habitat protection and restoration project design, construction, and operation in, near, or affecting aquatic systems (Appendix 2).

To date however, many watershed assessments have been based on limited data and studies supplemented with observations and expert opinions. They are often focused on identifying site- or reach-specific conditions that may be symptoms of underlying problems rather than diagnosing causes of the conditions. These assessments provide information needed for habitat conservation strategies when the causes of degraded conditions are obvious and there is a high level of confidence that specific conservation actions will result in the desired positive response. However, success at protecting and restoring habitat over the longer term is less likely if projects and actions continue to be implemented without adequate understanding of the surrounding watershed. Therefore, it is crucial to assess and determine the causes of habitat conditions at the onset and to assimilate the information into the planning and design of protection and restoration projects.

What more is needed?

The critical condition of many salmon stocks demands that we assess, plan, and act concurrently. So, we need a framework that ties completed assessment work with later, more sophisticated analyses along a path that leads to recovery of salmon. In many areas, watershed groups have completed initial assessment work that should be used to develop initial watershed conservation strategies, including effective projects that provide tangible benefits to salmon, have a low risk of causing harm, and a high chance of being successful.

To make habitat project decisions of a more strategic nature, we must improve our understanding of past, present and future habitat conditions and stock status; our ability to identify the underlying causes of habitat problems; and our understanding of salmon responses to habitat improvements. We need to progress toward more comprehensive and sophisticated assessment work that will allow us to evaluate our watersheds at multiple geographic scales and over the long term. We need to be able to define desired future conditions to support quantifiable recovery goals.

In addition, with a few exceptions there has been relatively little monitoring of the biological response to habitat improvements; consequently, little information exists about the effectiveness of our actions. Focused adaptive management programs to address key uncertainties identified by assessments generally do not yet exist. Data collection for assessments needs to be more standardized and easily accessible. We also need to improve the reliability and use of analytical models to help quantify likely effects of our actions, and develop adaptive management programs where our understanding needs to be improved.

What are we proposing?

It is important to acknowledge the many watershed assessments that are underway or have been performed. The ***Guidance on Watershed Assessment for Salmon*** builds on and integrates these approaches and results with ongoing needed assessment work in a context that can lead to effective recovery of salmon. This context will help local groups organize, evaluate, and complete their assessment work and decide priorities for information, analysis, projects, and monitoring. The ***Guidance*** recognizes that comprehensive assessments cannot occur everywhere all at once. Information and analyses can be bolstered as focused needs are identified and fiscal resources are available.

While the ***Guidance*** focuses on salmon habitat, the key activities and products have a broader utility to other initiatives, such as water quality and water supply assessments.

What questions are answered by watershed assessment?

Watershed assessment consists of three stages organized around the following key questions:

- *What habitat conditions are limiting salmon production?*
- *What processes or land uses are causing the habitat conditions?*
- *What are the linkages between salmon and habitat conditions?*

It is important to note that staging assessment work does not preclude making decisions and taking action prior to completing all of the elements of assessment referenced in the ***Guidance***, nor does it require that a specific tool or method be used.

What are the principles underlying this Guidance?

The ***Guidance*** is based on the following principles:

- *Its goal is to support salmon recovery efforts on the basis of the best scientific information that is available while additional assessment work is being performed.*

- *The watershed is the proper scale for effective salmon habitat conservation.* The biological and physical context of a watershed is necessary for identifying ecosystem issues in the watershed, for understanding the effects of humans on salmon and their habitat, and for designing locally-based conservation strategies that can be meaningfully linked to efforts at regional scales.

- *Understanding and focusing on processes that form, connect and sustain freshwater, estuarine and nearshore marine habitats for salmon is key to sustainable salmon habitat conservation in the long term.*

- *Understanding the relationships between past, present, and future habitat conditions and stock status is essential to successful recovery.* These relationships are important when predicting salmon responses to habitat improvement, and prioritizing recovery actions. They also help define desired future conditions and determine quantifiable objectives for habitat conservation.

- *Although there is much we know about salmon and their habitat, there is also much uncertainty.* Assessment, data collection, and monitoring will be needed to address data gaps and improve decision-making. Salmon and their habitats are highly variable in nature, and responses to many conservation actions will be detectable only after decades of salmon generations.

How should this Guidance be used?

This Guidance will assist local groups and funding entities to:

- evaluate the adequacy of existing assessment information and the level of confidence in information generated;
- relate information from assessments to decisions that can be supported, including categories of habitat conservation projects;
- point out assessment information that will help ensure the greatest potential benefit to salmon from projects;
- support specific guidelines; e.g., *Aquatic Habitat Guidelines* that are currently being developed for selecting and designing protection and restoration techniques and projects (Appendix 2);
- determine project sequencing;
- streamline decisions;
- identify priority problems and areas needing action or further assessment;
- prepare assessments which support Endangered Species Act (ESA) compliance determinations; and
- develop salmon habitat conservation strategies and plans for watersheds.

This guidance is not:

- intended to be a manual explaining how to do assessment - work is underway to explore the need for a "how to" document;
- regulatory – however, we urge funding organizations to include the guidance as part of their grant-making programs and processes; nor
- the final word - it will be periodically updated.

Part Two
Stages of Assessment

Part Two
Stages of Assessment

Why are stages needed?

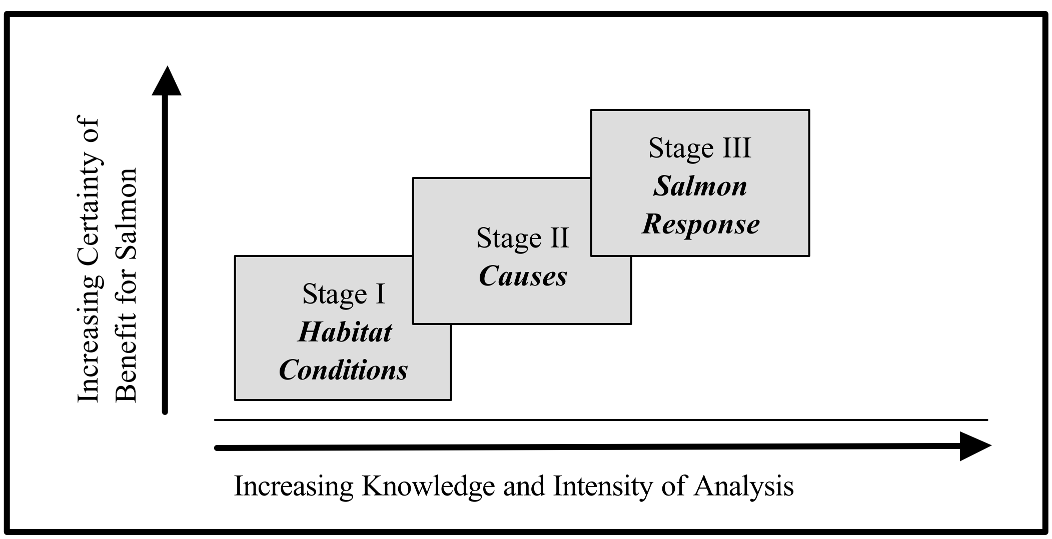
Answering key questions about problems that limit salmon production in watersheds, what is causing those problems, and what habitat actions would most appropriately address the problems and their causes, requires complex and time consuming technical work. The tasks involved are just too large to do comprehensively everywhere in the state all at once. As an alternative, this ***Guidance*** envisions assessment work in "stages." Each stage contributes a major piece of the comprehensive watershed assessment jig-saw puzzle. Thus the stages of watershed assessment described in this ***Guidance*** provide a way to make decisions associated with salmon recovery while more comprehensive assessment work is being completed.

How are the stages distinguished?

Three stages are identified in the ***Guidance***. They are *Stage I - Habitat Conditions, Stage II - Causes of Conditions, and Stage III - Salmon Response to Conditions.* These stages are organized around addressing the following key questions: (1) what habitat conditions are limiting salmon production? (2) what processes or land uses are causing the habitat conditions? and (3) what linkages exist between salmon and habitat conditions?

The three stages may or may not be sequential in each watershed; however, they do build on and depend upon each other and are likely to overlap. Each stage in the assessment ***Guidance*** utilizes information from preceding stages. Information at each stage may be highly variable. However, the path from Stage I to Stage III provides an increasingly robust, analytical framework to support actions needed to address the corresponding and increasingly difficult issues associated with salmon recovery. New methods or approaches will be needed to address some information gaps or to provide new and improved ways of analyzing and managing information.

Figure: Stages of Watershed Assessment



Each stage supports a range of decisions. For example, Stage I will support decisions associated with projects that address obvious causes of habitat conditions (e.g., fish passage barriers). In contrast, Stage II assessments support more complex issues and decisions associated with the maintenance or restoration of habitat-forming processes. Regardless of the stage, however, the knowledge gained from additional assessment work will reduce uncertainties and increase probabilities that decisions made will lead to desired outcomes.

Watershed assessments rely on a wide range of methods for understanding fish, their habitats, and natural processes that create and maintain those habitats. The ***Guidance*** emphasizes use of available methods and information sources, and identification of where information is absent or inadequate.

Table: Distinguishing Features of Assessment Stages

	Stage I ***Habitat Conditions***	**Stage II** ***Causes***	**Stage III** ***Salmon Response***
Level of Understanding	Good understanding of habitat conditions and environmental factors limiting salmon production	Good understanding of causes of habitat conditions as well as habitat forming processes	Good understanding of link between salmon production and habitat conditions
Level of Information	Existing information mostly on salmon and habitat conditions	Existing information plus analysis, and modeling	Extensive information from previous stages plus filled data gaps and modeling
Level of Effort and Analytical Rigor	Low Use best professional judgment	Moderate Geographic Information System (GIS) overlays, models and other analytical tools; may use some best professional judgment	High Multiple models used; parameters based on actual measured relationships within the watershed
Expertise Needed	Performed by scientists with local expertise	Technical, multi-disciplinary	Technical and multi-disciplinary and modeling expertise
Decisions Supported	Limited	Complex with higher probability of success	Comprehensive and with highest probability of success

What are data and information management considerations?

Improving data accessibility will lead to improved management practices and a greater interest in using data standards. It also will reduce the variability in data and information and will enhance the utility of analysis and modeling work at and across multiple scales of interest (e.g., sites, sub-watersheds, watersheds regions). Funding agencies are interested in improving the identification and use of standards, protocols and points of data access.

This assessment ***Guidance*** is not intended to address these issues in detail; however, concerns and considerations are identified here to guide data users and collectors toward improved access, quality, and management of data.

Each stage of this ***Guidance*** requires use of existing information; some stages may lead to collection of new data. Use of existing and/or new data offers many challenges when age, purpose, scale, geographic coverage, quality, and level of documentation are considered. This is true whether the data are held by a user or obtained from some other source.

Care should be taken to be certain the data available are appropriate to the assessment question or issue being addressed. Users should look closely at available information to ensure that it is the appropriate age, of sufficient quality, and that characteristics of the information or data (e.g., accuracy, completeness, collection and data handling protocols, underlying data analyses) are appropriate.

Some basic sources of information are identified in the ***Guidance*** for each stage (Appendix 1). These are not complete nor meant to be used as requirements or standards. Those performing assessments should obtain and use the best information available for their watershed.

In summary, at any given point in time, the benefits to salmon from conservation actions should be directly related to the nature and extent of watershed assessment information that is available. Over time, as work progresses on efforts to better describe and analyze issues associated with the causes of watershed conditions, and to understand the relationships between salmon production and habitat conditions, more complex conservation efforts can be developed and implemented with higher probabilities of success. In addition, adaptive management and monitoring are needed to improve our understanding of critical uncertainties, to allow us to make mid-course corrections based on better information, and to ensure our actions are effective. Indeed, with many restoration efforts underway, if appropriate monitoring is in place, these actions can provide data to improve the understanding of how changes in habitat conditions will affect salmon performance.

STAGE I — Habitat Conditions

This stage of assessing what habitats are limiting salmon production relies on currently available information supplemented by professional knowledge and judgment. The focus of this stage is on understanding environmental factors and habitat conditions in the watershed (including adjacent nearshore marine and estuarine areas), status and distribution of salmon stocks, and the general extent to which habitat conditions are affecting salmon populations. Many existing technical studies, such as LFAs completed by the Washington Conservation Commission, provide good information on habitat requirements for salmon, habitat factors limiting salmon populations, and salmon stock status and trends. LFAs generally provide thorough documentation of conditions based on extensive review of available scientific literature, agency reports and databases, and unpublished information. They contain recommendations to support initial development of conservation strategies (Appendix 1).

Synthesis of information from this assessment stage can help local groups determine habitat in need of protection and/or restoration, the extent and relative severity of major limiting factors, and key information gaps. Existing data for many watersheds is inadequate, both in level of detail and geographic scope. Information is particularly limited with respect to the overarching causes of habitat problems. Thus, the types of decisions that can be made with high confidence on the sole basis of Stage I assessment are restricted.

There are three steps in Stage I assessment:

Step 1	Describe the watershed and habitat conditions
Step 2	Describe the stock status and trends
Step 3	Synthesize information

Step 1 – Describe the Watershed

Purpose:
Establish the landscape context for watershed assessment for salmon.

Answers questions including:

- ? What are the important or relevant features of the watershed?
- ? What are the current conditions?
- ? How do conditions diverge from what is expected of a healthy watershed?
- ? What habitat conditions limit salmon production?

Products:

- General narrative description of the watershed including adjacent nearshore marine and estuarine areas.
- Description of factors that affect the watershed from within and outside.
- Description of habitats limiting salmon production.
- Description of level of confidence in the information used to develop narratives.

Key Activities:

- Describe the general physical, biological, and chemical attributes of the watershed (e.g., geology, climate, topography, hydrography).
- Identify and describe factors within the watershed, both natural and human-caused, that affect physical, biological, and chemical attributes of the watershed. This includes analysis of:
  - Hydrologic conditions—low flows, peak flows, water use, land cover, off-channel storage, and impervious surfaces;
  - Soil erosion and sediment load and sources (e.g., roads, landslides);
  - Natural vegetation patterns and characteristics—riparian, upland, and large wood recruitment;
  - Wetland, floodplain, and nearshore/estuary functions and conditions (e.g., diking, dredging and channelization); and
  - Water quality condition.
- Identify and describe human-caused factors existing outside of the watershed that affect the physical, biological, and chemical attributes of the watershed; (e.g., an upstream dam that regulates flow, modifies water temperature, and restricts sediment and wood movement downstream into the watershed).
- Identify areas of disconnected habitat and human-caused barriers (e.g., dams, temperature barriers, culverts, dikes, levees, tide gates) that restrict salmon access to historically accessible habitats.
- Describe adjacent marine nearshore and estuary characteristics and their relationship to the freshwater environment within the watershed.
- Classify and subdivide the watershed into sub-watershed and stream reaches to facilitate comparative assessment of habitat conditions at coarse, medium, and finer scales. This classification step is critical for Stage III assessment.
- Identify data gaps that need to be filled to reduce uncertainty in the development of recommendations to address problems with habitat condition.

Information sources include:
LFAs; watershed assessment under the Watershed Planning Act; GIS coverage; maps and inventories including: Watershed/Hydrography layer, land use/land cover, Topography/Digital Elevation Model data, 303(d) water quality data, dams, culverts and other types of barrier inventories, SSHIAP, Wetlands Inventory, state and federal watershed analyses.

Step 2 – Describe Stock Status and Trends

Purpose:
Understand current status, trends, and life history of salmon stocks, including their geographic distribution.

Answers questions including:

? What are the species and stocks in the watershed, and where are they located?

? What is the historic and current abundance and distribution of salmon in the watershed?

? How do different life histories contribute to diversity and distribution of stocks?

Products:

- Narrative description of salmon species and stocks, status, abundance, diversity, productivity, and trends.
- Maps and tables displaying the information.

Key Activities:

- Identify and generally describe the salmon species and stocks and their status, abundance, current and historic distribution, diversity, and trends in the watershed.
- To the extent that information is available, describe the historic and current productivity of stocks in the watershed including quantity and quality of habitat used by the stocks.
- Describe the historic and current life history diversity by stock.
- Identify data gaps, limitations and uncertainty of information.

Information sources include:
LFAs; Salmonid Stock Inventory (SaSI); National Marine Fisheries Service (NMFS), US Fish and Wildlife Service (USFWS), state and tribal technical documents; Ecosystem Diagnosis and Treatment (EDT); SSHIAP; refugia studies; and State/tribal spawner escapement and run reconstruction data.

Step 3 – Synthesize Information

Purpose:
Identify and prioritize factors affecting salmon production in the watershed and identify critical preservation and restoration actions.

Answers questions including:

? What is the extent and nature of human-caused factors affecting salmon habitat production in the watershed?

? How much is understood about effects of land and water use on habitat alterations?

? At what (freshwater or estuarine) life history stage do habitat conditions have the greatest effect (if information is available)?

Products:

- A list of sub-watersheds or stream reaches that have habitat with the greatest potential to contribute to recovery of salmon stocks.
- A list of sub-watersheds or areas that are currently providing salmon habitat and are necessary to sustain their survival.
- Information for local watershed groups and funding entities to use in generating lists of critical preservation and restoration projects and actions.
- Description of geographic areas and/or habitat conditions that are highest priority and need further assessment work.

Key Activity:

- Evaluate and synthesize all existing information

Decisions Supported by Stage I Assessment of Habitat Conditions

Stage I provides initial information upon which to base salmon habitat conservation decisions. Although the extent and quality of existing data are usually limited, thus restricting the range of decisions made, information from this stage can be used to help develop and prioritize initial conservation strategies and actions. Stage I assessment supports strategies focused on preserving remaining high quality habitat, protecting key habitat from further degradation, and restoring habitat where the benefits to salmon are obvious.

The range of decisions most likely to be supported by information from Stage I assessments is limited to some project categories and regulatory land use actions. It may include:

<u>Preservation and Restoration Projects</u>

- Projects such as acquisition by fee title and less than fee ownership; fish bypass facilities; culvert improvements; riparian habitat livestock fencing; stormwater attenuation;
- Restoration of access to habitat historically available to salmon, particularly habitat in good condition; and
- Improvement of connectivity between functioning habitat.

More detail on the categories of projects that are most likely to be supported by Stage I assessments is provided in Part Three of this ***Guidance.*** It is important to note that site- and reach-specific assessments and design work will be needed to select specific projects. For example, *Aquatic Habitat Guidelines* specific to the design of habitat protection and restoration projects are currently being developed by an interagency group with representatives from the Washington State Departments of Fish and Wildlife (WDFW), Ecology (ECY), and Transportation (WSDOT) with assistance from a variety of experts from other agencies, academic interests, and private organizations. That and other examples are referenced in Appendix 2. For information on these guidelines, please refer to the web at www.wa.gov/wdfw/hab/salguide/salguide.htm.

<u>Land Use</u>

Land use actions such as acquisition or other improved habitat protection measures (e.g., floodplain ordinance, critical areas ordinance, and water conservation) to stop habitat degradation and help maintain current habitat in need of immediate protection.

<u>Other</u>

Actions to address priority information gaps and related data collection and monitoring needs.

STAGE II — Causes of Condition

Although Stage I assessment will identify factors affecting salmon and their habitats, ensuring conservation actions are increasingly appropriate and effective will depend upon understanding the root causes of habitat conditions and their relationships to human activities. Stage II assessment ***Guidance*** encourages local groups to focus their work on understanding fundamental, cause-and-effect relationships that determine the extent to which habitat in the watershed can sustain salmon. Understanding the causes of habitat degradation needs to happen at multiple spatial scales: landscape/watershed (including nearshore/marine and estuary, if appropriate), sub-watershed, and reach-specific. Stage II assessment focuses at the watershed and sub-watershed scales. Reach-scale information is collected as part of Stage I and/or Stage III assessments.

> ***Habitat-forming processes*** are the physical agents of landscape pattern formation and maintenance; i.e., the natural rates of delivery of water, sediment, heat, organic materials, nutrients, and other dissolved materials.

Stage II assessment integrates and builds upon Stage I assessment. Information from Stage I can help focus assessment of habitat-forming processes to areas that are altered or may be altered in the future. However, it is important to understand that Stage II can occur concurrently or sequentially with Stage I.

Stage II assessment relies on existing information, and large-scale landscape/watershed analysis using GIS, models, and other tools. It requires the use of multi-disciplinary technical expertise.

Local groups engaged in ongoing assessments should increasingly focus their work on understanding habitat-forming processes, and the influences on these processes. This emphasis will improve our ability to develop and implement watershed-based strategies for salmon habitat conservation.

There are two steps in Stage II assessment:

Step 1 Identify and describe habitat-forming processes and the causes of change
Step 2 Synthesize information

Step 1 - Describe Changes to Habitat-forming Processes

Purpose:
Assess the extent of past, current, and future human-caused changes to habitat-forming processes and identify core problems that cause habitat degradation.

Answers questions including:

? How does the watershed work?
? What are the most important habitat-forming processes in the watershed that are responsible for creating and maintaining habitat for salmon?
? How have these processes changed from the past?
? What is likely to change in the future, and where?
? Where should sub-watershed processes be further assessed?

Products:

- A description of habitat-forming processes in the watershed.
- A narrative description of disturbance regimes, both natural and human-caused, that are shaping watershed processes.
- A list of sub-watersheds/areas evaluated by extent or risk of human-induced alteration to habitat-forming processes, and by risk of future alteration.
- A suite of GIS coverages that supports assessment and narrative descriptions.
- A list of sub-watersheds with priority for further assessment.

Key Activities:

- Watershed characterization described in Stage I assessment (e.g., characterization of hydrologic regime, sediment load).

- Identify habitat-forming processes that create and maintain freshwater habitat characteristics important to salmon. At a minimum, the following core habitat-forming processes should be identified and assessed at the watershed scale:
  - *Delivery and routing of water* – groundwater and surface water modifications to natural hydrology. Use water budget developed under the Watershed Planning Act watershed assessment process, if available.
  - *Delivery and routing of sediment* – mass wasting (coarse and fine sediment) surface erosion, bank stability, landslide assessment. Use sediment budget and modeling, if available.
  - *Delivery and routing of organic materials* – large woody debris (LWD) and organic carbon, riparian area assessment. Use organic and LWD change modeling, if available.
  - *Delivery and routing of nutrients and toxins and suspended and dissolved materials* – role and status of salmon carcasses, total nitrogen, total phosphorous, heavy metals, and toxics. Use Total Maximum Daily Loads (TMDLs) at watershed scale, if available.
  - *Delivery of heat* – shade driven, groundwater and surface water (including withdrawal) driven, and sediment driven; direct water temperature sampling; riparian assessments. Use temperature modeling, TMDLs at watershed scale, if available.

- Identify habitat-forming processes that create and maintain estuarine/marine habitat characteristics important to salmon. At a minimum, the following core habitat-forming processes should be assessed:
  - *Delivery of water* – marine circulation (modeling); evaluation of wave energy and exposure; tide cycle. Use water budget developed under the Watershed Planning Act watershed assessment process, if available.
  - *Delivery of sediment* – littoral drift; shoreline and upland modifications altering sediment supply. Use sediment budget and modeling, if available.
  - *Delivery of organic materials and organic carbon* – effects of eutrophication-related overproduction on supply of organic material and organic carbon from marine riparian vegetation. Use organic and LWD change modeling, if available.
  - *Delivery of nutrients and toxins* – excess delivery of nutrients (eutrophication) leading to excess production and deposit of toxics in sensitive shoreline areas and embayments. Use TMDLs at watershed scale, if available.
  - *Delivery of heat and light* – need for light to support intertidal and shallow subtidal primary productivity; effects of light limitation from over water structures and increased turbidity. Use temperature modeling, TMDLs at watershed scale, if available.

- Identify natural disturbances to habitat-forming processes under predevelopment conditions (e.g., climate, fire, floods). This information should be used as a baseline to assess human-caused effects from past, current, and future land uses.

- Identify human-caused disturbances and compare to natural disturbances. Compile available information on past/current human land use and how each land use type has influenced habitat-forming processes.

- Compare human and natural disturbances under past and current land use conditions and assess how humans have altered the natural disturbance regimes in the watershed.

- Develop a picture of future anticipated land use, using Comprehensive Growth Management Plan or other local planning tools.

- Assess the potential and likelihood of human alteration to each habitat-forming process by sub-watershed, and compare sub-watersheds based on current and potential change in each habitat-forming process.

- Identify sub-watersheds with the greatest risk of human-caused process alteration under both current and potential future land use conditions.

- Identify data gaps, limitations of information, and certainty of results at the watershed and sub-watershed scales and set priorities for further assessment.

Information sources include:
LFA reports, watershed assessment under the Watershed Planning Act; TMDLs; SaSI; NMFS and USFWS data and technical documents (e.g., Cumulative Risk Initiative (CRI)); SSHIAP; State/Tribal spawner escapement and run reconstruction data; refugia studies; university publications; inventories of habitat-forming processes (e.g., sediment and wood budget, landslide inventories, riparian assessment); state and federal watershed analysis; US Geological Survey (USGS); historical references.

Step 2 – Synthesize Information

Purpose:
Identify and prioritize areas and conservation strategies to maintain reasonably intact habitat-forming processes and restore habitat-forming processes where they are altered now and are likely to be so in the future.

Answers questions including:

? What are the core causes of habitat degradation?

? What processes have been altered and where?

? Which sub-watersheds (and the areas within them) have the greatest potential for contributing to overall salmon recovery in the watershed?

? Which of those sub-watersheds are most threatened by potential future development?

Products:

- The changes in habitat-forming processes or land uses that are causing habitat problems, and the risks of future alteration are understood.

- Identification of current and future strongholds.

- Identification of conservation projects and actions.

Key Activities:

- Identify and prioritize sub-watersheds (including marine/estuarine areas) where restoration of habitat-forming processes has the greatest potential to contribute to recovery of salmon stocks. In general, highest priority sub-watersheds for habitat-forming process-based restoration actions should have:
  - limited habitat-forming process alteration (all but one or two habitat-forming processes reasonably intact);
  - historically provided essential habitat for one or more salmon life stages;
  - historically supported significant proportion of watershed's total salmon production;
  - land use impacts that caused habitat-forming process alteration are considered reversible;
  - available habitat being used by salmon or good potential to support salmon with restoration; and
  - ability to be protected from future threats.

  While this outline can be used as general guidance, local technical teams should tailor criteria specific to their watershed.

- Identify and prioritize sub-watersheds (including marine/estuarine areas) where the restoration of habitat-forming processes should focus, using criteria developed above. Sub-watersheds will range from no alteration in habitat-forming processes under past/current and future land uses to severely degraded sub-watersheds that have multiple habitat-forming process alterations under past/current and future conditions. This step seeks to identify those sub-watersheds that have the greatest potential to contribute to salmon recovery and have land use disturbances that have potential to be reversed.

- Identify and prioritize sub-watersheds that are currently functional and serve as salmon strongholds. Salmon strongholds are sub-watersheds/areas with intact habitat-forming processes and available habitats that are being occupied by salmon. These areas serve as the foundation for recovery planning by acting as core areas that recovery efforts build on, and should be identified for each salmon life stage. Suggested criteria for prioritizing sub-watersheds as salmon strongholds:
  - The sub-watershed is accessible to one or more salmon stocks.
  - Status of salmon productivity in the sub-watershed is considered stable to healthy.
  - Habitats within the sub-watershed have experienced minimal alteration from past human land uses.
  - Habitat conditions within the sub-watershed are considered good to excellent.
  - The sub-watershed is considered essential for the maintenance of functional downstream habitat.
  - Future land use and other activities are not likely to degrade the habitat.

  Other factors should be considered by local groups and funding entities, such as willingness of landowners to protect and maintain salmon strongholds.

> ***Salmon stronghold*** or ***refugia*** are areas where salmon populations are healthy and habitat exists to maintain that healthy status (see NMFS guidance, 1996).

- Establish criteria for identifying potential, future salmon stronghold sub-watersheds. In general, future stronghold areas should meet the following criteria:
  - The sub-watershed is accessible to salmon, or access will be effectively restored.
  - Habitat-forming processes within the sub-watershed have only limited alteration or are recovering from past and/or current land uses. Sub-watersheds with increasing levels of habitat-forming process alteration should be ranked lower when identifying future stronghold areas.
  - Habitat conditions within the sub-watershed are fair or better, and opportunities to restore habitat-forming processes are not precluded by existing land uses.
  - Future land use and other activities are not likely to degrade the habitat.

- Identify conservation actions and projects that protect good habitat, open disconnected habitat in floodplains and estuaries, improve connectivity and access, and restore habitat-processes. This can be done using broad scale strategies (regional, watershed, or sub-watershed) and prioritization exercises.

- Identify data gaps that need to be filled to reduce uncertainty in the selection of salmon stronghold areas and prioritize of projects that will support productivity of those areas.

Decisions Supported by Stage II Assessment of Causes of Habitat Conditions

Information from Stages I and II together would substantially bolster the strategic basis for recovery work (e.g., projects and land management actions). Stage II assessments provide more substantive information for local groups and funding entities to identify and select increasingly more complex conservation projects and actions likely to produce correspondingly greater long-term benefits to salmon.

A broad range of decisions is supported by Stage I combined with Stage II assessments. Habitat conservation strategies supported at this stage should include more substantial preservation, protection and restoration activities, and will increasingly include land use actions.

<u>Restoration Projects</u>

- Projects such as fishways and log or rock control weirs; dike removal/setback; channel connectivity and off-channel habitat; wetland restoration; shoreline restoration; woody debris placement; process-oriented in-channel work; complex log jams; channel reconfiguration; riparian vegetation planting; plant thinning, removal, and control; road erosion control; road abandonment and decommissioning.

More detail on the categories of projects that are most likely to be supported by Stage II assessments is provided in Part Three of this ***Guidance.*** It is important to note that site- and reach-specific assessments and design work will be needed to select specific projects. For example, *Aquatic Habitat Guidelines* for design of protection and restoration projects are currently being developed by an interagency group involving the WDFW, ECY, and WSDOT with assistance from a variety of experts from other agencies, academic interests and private organizations. That and other examples are referenced in Appendix 2. For information on these guidelines, please refer to the web site at www.wa.gov/wdfw/hab/salguide/salguide.htm.

<u>Land Use</u>

- Land use actions such as acquisition and improved habitat protection measures (e.g., floodplain ordinances, critical areas ordinances, water conservation and surface water runoff management) to stop habitat degradation and help preserve and maintain those habitat areas or processes identified as having the greatest potential to contribute to recovery of salmon.

<u>Other</u>

Actions to address priority information gaps and related data collection and monitoring needs.

STAGE III — Salmon Response

Stage I assessment identifies habitat conditions and factors limiting salmon populations and their habitat. Stage II focuses on understanding the root causes of habitat conditions and their relationships to human activities. Successful conservation actions require understanding how and when salmon stocks utilize different parts of freshwater, nearshore marine and estuary systems, and the relationships between salmon life stages and habitat type and condition. Stage III assessment focuses on that understanding by linking salmon to habitat characteristics and conditions.

This stage draws upon Stage I and II, plus new information, including extensive field data and modeling tools. Specifically Stage III relies on experiments, field observations, monitoring data, predictive modeling, and use of adaptive management. It requires the most technical expertise, focusing on using long-term monitoring and quantitative models that measure and predict linkages between salmon abundance, productivity and habitat capacity. The objective of this stage is to understand how productivity and spatial distribution of salmon production relate to habitat conditions. This information, with the understanding of limiting factors and the processes that form and sustain habitats, will allow critical examination and prioritization of different types of possible conservation actions. It will be a key component of watershed and regional recovery efforts and may have utility in predicting the effects of potential land use decisions.

Information from Stage III assessment will be very useful for local governments engaged in land use decisions such as the level of protection for critical areas. Stage III assessment is essential if management decisions and restoration efforts are to be guided by the biological response of salmon. Information from all three stages should also reveal where critical uncertainties exist, around which adaptive management and monitoring can be focused.

Although the Stage III assessment guidance does not prescribe the use of any particular model, the best available approaches to support the decisions at hand should be used. Initially, expert systems may prove useful. As more substantial and difficult decisions need to be made, use of empirical approaches will become more important. Ultimately, choices in using modeling tools will depend on the objectives to be achieved, the data and resources available, and the level of uncertainty that is acceptable for proposed actions.

Analytical approaches for relating biological responses to habitat conditions to overall salmon recovery are rapidly evolving. Thus, Stage III guidance is limited at this time and will be updated.

There are two steps in a Stage III assessment:

Step 1 Define salmon life history and habitat relationships

Step 2 Synthesize information

Step 1 - Define Salmon Life History and Habitat Relationships

Purpose:
Identify habitat utilization by salmon in various life stages, where known, and how salmon abundance and productivity is influenced by habitat conditions.

Answers questions including:

? What are the linkages between habitat and fish productivity?

? What life stages are most limited by altered habitat condition, and where?

? What sub-watersheds, or areas within the sub-watersheds, and specific habitats are most important to one or more salmon life stage, now and likely in the future?

Products:

- Analysis of available information on salmon habitat utilization by life history stages (e.g., narrative, maps) for all life history strategies in the watershed.

- Compilation of available information on relationship of salmon productivity to habitat conditions in the watershed, including adjacent estuaries and nearshore marine areas.

Key Activities:

- Assemble watershed inventory and assessment data (including classification of the watershed into sub-watersheds and stream reaches); and stock status, trends, and life history from Stage I; and habitat-forming processes data (e.g., sediment supply, floodplain connectivity, riparian condition, hydrologic condition) from Stage II.
- Identify habitat types and locations used by each salmon life stage.
- Identify and locate habitat types with the strongest influence on stock abundance at each life stage, and identify the life history stage(s) and habitat linkages that appear to limit stock productivity.
- Identify areas of fragmented and disconnected habitat affecting stock movements and assess causes of the disconnection. Identify human-caused barriers that restrict salmon from historically accessible habitats and assess the fragmentation of habitat for each salmon life stage. This information may have been collected in Stages I and II.
- Identify potential habitat not currently being used.
- Identify data gaps, limitations of information used, and uncertainty of results.

Information sources include:
Field studies; university publications; smolt production information; WDFW and tribal documents; LFA reports; watershed assessments under the Watershed Planning Act; EDT analyses; SSHIAP; Salmonid Screening, Habitat Enhancement and Restoration (SSHEAR) culvert and fishway inventories; ECY inventories of dams; NMFS/USFWS and other federal recovery documents.

Step 2 – Synthesize Information

Purpose:
Identify and prioritize conservation actions based on predicted responses of salmon to various conservation scenarios.

Answers questions including:

? What are the relationships between salmon populations and habitat types and conditions?

? Where should recovery efforts be focused in the watershed?

? What actions will contribute the most to salmon productivity in the watershed?

Products:

- Quantitative analyses of management options and estimates of potential fish response under different habitat management scenarios.
- Focused basis for monitoring and adaptive management.

Key Activities:

- Synthesize assessment results from Stage I, II, and III which include information on the condition of habitats and the factors limiting salmon productivity; where processes are altered and the factors responsible; and the relationships between salmon and habitat types and conditions.
- Use analytical tools and models to develop hypotheses which link salmon to habitat conditions and predict salmon responses to restoration projects or actions. Various tools are being used and developed; for example, NMFS is focusing its efforts on building empirical (data-oriented) models based on statistical relationships between population attributes and habitat condition. NWPPC and Tribes/WDFW are focusing on an expert system (data plus expert opinion) – EDT.

Decisions Supported by Stage III Assessment of Salmon Response

Stage III assessments require the most rigorous and technically sophisticated level of analysis for watershed level salmon recovery strategies and actions. All aspects of decision-making, including priority setting, will be supported by this level of assessment. Decisions supported by Stage III would include protection of salmon strongholds, projects aimed at preservation and restoration of habitat-forming processes, and other management actions to increase habitat connectivity and establish a diverse network of habitats in freshwater and estuaries.

Stage III analysis provides key building blocks for salmon recovery planning not just within watersheds, but across adjacent watersheds, and across watersheds at regional scales. Ultimately, this information can be used in regional salmon recovery work that integrates and prioritizes conservation actions addressing harvest, hatchery, and hydropower issues, along with habitat issues, to achieve recovery goals for salmon. It also may help local governments target their land use actions.

Although there are relatively few examples of advanced Stage III assessments in the state at this time, they are receiving increasing attention. Stage III assessments, which build upon and integrate information from Stage I and II assessment work, create a technical foundation to more effectively prioritize all projects and recovery actions. This will help groups involved in salmon recovery develop more comprehensive habitat recovery strategies for their watersheds.

In summary, Stage III assessment synthesizes the information from all three stages and provides the combined benefits from that information. When used with the other stages, it represents a comprehensive level of assessment that will support all project decisions, will help frame key land use issues for resolution, and will establish a basis for adaptive management and monitoring.

Part Three
Categories of Projects

Part Three
Categories of Projects

Information from Stage I through Stage III assessments supports habitat preservation, protection, and restoration projects and conservation strategies. However, the category and type of projects varies considerably depending on the stage of assessment information available.

The following categories and types of projects are provided to guide local watershed groups and funding entities in aligning the information available with a type of preservation, protection, or restoration project. Considerations are identified that will increase benefits to salmon. Some types of projects may be selected and justified on the basis of information available for a sub-watershed rather than the whole watershed. This may be the case for many upstream projects. The categories and types also should assist in prioritizing and selecting projects based on assessment information.

It is important to note that site-specific assessment and design work will be needed to support specific projects. For example, *Aquatic Habitat Guidelines* specific to the design of habitat protection and restoration projects are currently being developed by an interagency group with representatives from WDFW, ECY, and WSDOT with assistance from a variety of experts from other agencies, academic interests and private organizations. That and other examples are referenced in Appendix 2. For information on these guidelines, visit www.wa.gov/wdfw/hab/salguide/salguide.htm.

The following categories and types of preservation and restoration projects are consistent with those used by the Salmon Recovery Funding Board. Within the seven categories (acquisition, instream diversions, instream passage, instream habitat, riparian habitat, upland habitat, and estuarine/marine nearshore), project types are organized alphabetically.

Use of the ***Guidance*** will help ensure that immediate risks to salmon are not excessive, consistent with the current information and level of understanding.

ACQUISITION

ACQUISITION includes the purchase of land, access, or utilization rights in fee title or by perpetual easement.

Acquisition by Fee Ownership

Description:
Acquisition of fee title or perpetual easements for high quality functioning estuarine, nearshore, freshwater aquatic, floodplain, and riparian habitat.

Benefits to salmon are increased if:

- Watershed assessment has identified high priority areas in need of preservation to protect high quality salmon habitat.
- On-site habitat-forming processes are relatively intact (riparian system consists of mature trees, channel can migrate over floodplain, floodplain capable of long-term sediment, high-flow, and nutrient storage).
- Up-slope habitat-forming processes are intact or mostly intact.
- Watershed upstream of acquisition is in protected status.
- Future land use change upstream of site will not substantially alter habitat-forming processes.

Acquisition of Water Rights

Description:
Acquisition of water rights for instream flow.

Benefits to salmon are increased if:
- Watershed assessment has identified the lack of instream flow as a priority issue adversely affecting salmon productivity.
- Instream flow studies demonstrate habitat benefits with purchased flow increment.
- Acquired water will be available to provide habitat considered to be a limiting factor for one or more salmon life stages.
- Watershed has streamflows and water withdrawals monitoring in place.

Acquisition of Utilization or Access Rights

Description:
Acquisition of easements for access, development, mineral, and timber rights.

Benefits to salmon are increased if:
- Watershed assessment has identified the acquisition as a high priority to protect high quality salmon habitat.
- The easement protects several habitat parameters and provides long-term conservation of the acquisition.
- Upstream habitat-forming processes are intact or mostly intact.
- Future land use change upstream or on-site will not substantially alter habitat-forming processes or important habitat features.
- Watershshed upstream of acquisition is in protected status.

INSTREAM DIVERSION

INSTREAM DIVERSION includes those projects that provide for the withdrawal and return of surface water, including the screening of salmon from the actual water diversion, the water conveyance system (both gravity and pressurized pump), and the by-pass of salmon back to the stream.

Fish By-pass/Fish Screen (gravity and pump)

Description:
Installation or upgrade of intake screen/bypass facilities at existing water diversions, to prevent entrainment.

Benefits to salmon are increased if:
- Watershed assessment has identified human-caused problems at water diversions, which are impeding migration of adult and/or juvenile salmon and/or causing entrainment of juveniles.
- Installation meets current fish exclusion standards, design methods, and guidance (WDFW or NMFS screening criteria) for all species potentially encountered at diversion site.
- Effective operation and maintenance program is in place.

INSTREAM PASSAGE

INSTREAM PASSAGE includes those projects that provide salmon migration up- and downstream and include road crossings (bridges or culverts), barriers (dams, log jams), fishways (ladders, chutes, pools), and log and rock weirs.

Bridge

Description:
A water-crossing (over-water structure) that retains or restores natural channel conditions, maintains ecological connectivity; avoids geologically unstable areas; considers cumulative impact for direct loss of habitat; and minimizes streambank vegetation disturbance.

Benefits to salmon are increased if:
- The structure does not result in a constriction (narrowing) of the river channel.
- The structure does not impede the downstream transport of LWD and sediment.
- The floodplain at the bridge site is allowed to function naturally.
- Bridge design precludes run-off (and pollutants) from directly entering the channel.
- Riparian vegetation loss is minimized.

Culvert Improvements

Description:
The removal and/or installation of either a new or replacement of a stream culvert (including hanging culverts) to provide efficient passage of adult and juvenile salmon, and improve stream function.

Benefits to salmon are increased if:
- Watershed assessment has identified specific barriers that preclude or restrict access to historic salmon habitat, and/or cause loss of habitat connectivity.
- Design/installation meets current WDFW fish passage design methods and guidance.
- Upstream watershed hydrology is relatively stable.
- Downstream channel bed is relatively stable.
- Upstream sediment inputs are within natural range of variability.
- Future land use change upstream of site will be minimal and anticipated increases in peak flows are incorporated into culvert design.
- Project has been evaluated and prioritized according to the severity of the passage problem, amount/quality of habitat upstream, potential species interactions, and species use.
- Culvert is not installed in salmon spawning area during a time when salmon utilize the area.
- An effective maintenance program is in place
- Culvert design precludes run-off (and pollutants) from directly entering the stream channel.
- Riparian vegetation loss is minimized.

Dam Removal

Description:
Work at small dams to remove impediments to salmon and sediment passage.

Benefits to salmon are increased if:
- Watershed assessment has identified specific barriers as a causal mechanism for loss of habitat connectivity and prioritizes fish passage barriers that preclude access to historic salmon habitat.
- The up- and downstream channel bed is relatively stable.
- Disposition of sediment build-up behind the dam has been properly addressed.
- Feasibility studies have considered/addressed the potential for scouring after removal.

Diversion Dam

Description:
Replacement or modification of a diversion dam to improve passage of salmon.

Benefits to salmon are increased if:
- Watershed assessment has identified fish passage as a limiting factor at the structure.
- Design/installation of improvements meet current WDFW fish passage design methods and guidance.
- An effective operation and maintenance program is in place.
- Adequate instream flow is available year-round to operate passage facilities.

Fishways and Log/Rock Control Weirs

Description:
Structures or systems designed to facilitate fish passage including salmon attraction features, barrier dams, entrances, auxiliary water systems, and exits. Log or rock weirs/structures placed in the streambed to influence stream functions such as flow, gradient, sediment, or bed elevation. Culverts (even if "fish friendly") are not considered fishways.

Benefits to salmon are increased if:
- Watershed assessment has identified specific barriers as the cause to loss of habitat connectivity and access to historic salmon habitat.
- Structure designed to WDFW design standards, methods, and guidance.
- Alternatives assessment has been conducted.
- Upstream hydrology and sediment processes are within natural range of variability.
- Downstream channel bed is relatively stable.
- Future land use change upstream of site will be minimal and anticipated increases in peak flows are incorporated in design.
- Potential upstream species interactions are assessed and addressed.

- An effective operation and maintenance program is in place.
- Adequate instream flow is available year-round to operate passage facilities

INSTREAM HABITAT

FRESHWATER INSTREAM projects include activities that enhance fish habitat below the ordinary high water mark of the water body. Projects include work conducted on or next to the channel, bed, bank, and floodplain by adding or removing rocks, gravel, concrete, or woody debris. Other actions necessary to complete the project may include livestock fencing, water conveyance, and plant removal and control.

Bank Stabilization

Description:
Stabilization of a streambank to minimize erosion and sedimentation.

Benefits to salmon are increased if:
- Watershed assessment has identified sedimentation from streambank erosion as a limiting factor for salmon.
- Bio-engineering solutions are implemented that incorporate LWD into design.
- Natural habitat-forming processes and floodplain function are not precluded by the stabilization.
- Potential up- and downstream impacts of stabilization are assessed and addressed.
- Revegetation to create a functional riparian zone is a component of the project.

Carcass Placement

Description:
Placement of salmon carcasses in streams to enhance nutrient levels in the stream ecosystem.

Benefits to salmon are increased if:
- Watershed assessment has identified marine nutrient deficiency as a limiting factor
- Project meets WDFW *Fish Health Guidelines and Protocols*, and WDFW *Guidelines for Distributing Salmonid Carcasses to Enhance Stream Productivity in Washington State*.

Channel Complexity and Off-Channel Habitat

Description:
Reconnection of pre-existing or new high quality off-channel habitat that does not require a formal fish passage facility; includes improving or creating new habitat for salmon rearing and spawning.

Benefits to salmon are increased if:
- Watershed assessment has identified alteration in the routing of water and resulting loss of channel complexity, and loss of off-channel habitat as a limiting factor for salmon.
- Upstream habitat-forming processes are relatively intact.
- Downstream channel bed is relatively stable.
- Upstream hydrology and sediment processes are within natural range of variability.
- On-site habitat-forming processes are intact (riparian system surrounding the off-channel habitat consists of mature trees, channel can migrate over floodplain, floodplain capable of long-term sediment, high-flow, and nutrient storage).
- Project addresses the spatial and temporal habitat needs limiting identified salmon life stages.
- Future land use change upstream of site will be minimal and anticipated seasonal flow patterns are considered in project design.
- Fish access to reconnected habitats is provided by normal hydrologic regime.
- Long-term landowner agreement has been secured.

Channel Reconfiguration

Description:
Projects that attempt to create a new - or redesign an existing - specific habitat type (pools, spawning habitat, etc.), or influence or redirect the flow, pattern or hydraulics of a stream to reduce or increase erosive forces acting on a stream bank or stream bed, including deflectors, barbs, and vanes.

Benefits to salmon are increased if:
- Watershed assessment has identified the need for habitat creation/construction to satisfy short-term habitat requirements for salmon, while habitat-forming processes are being restored.
- Upstream hydrology and sediment processes are relatively intact and within the natural range of variability; there is an adequate understanding of habitat-forming processes to ensure the project will remain functional over time.
- Downstream channel is relatively stable.
- Future land use change upstream of site will not degrade habitat-forming processes.
- Project addresses the spatial and temporal habitat needs limiting identified salmon life stages.
- Project is designed and conducted by experienced design and construction personnel.
- Projects are located in groundwater discharge areas away from the most active channel.

Complex Log Jams

Description:
Construction of in-channel engineered log jam (ELJ) complexes in large rivers.

Benefits to salmon are increased if:
- Project addresses an identified limiting factor for the reach.
- A pre-project-specific channel assessment is completed.
- Upstream hydrology and sediment processes are relatively intact, and within the natural range of variability.
- Project maintains channel conveyance of sediment and water, and dispersal of large wood.
- Design is carefully developed and project implemented by qualified professionals experienced in ELJ placement.
- An effective maintenance program is in place.

Dike Removal or Setback

Description:
Dike breaching, setback, or removal that re-establishes on-site habitat-forming processes (delivery and routing of water, sediment, nutrients, and wood) to an estuary or floodplain that restores floodplain or estuarine function, including the restoration of off-channel habitats.

Benefits to salmon are increased if:
- Watershed assessment has identified removal/relocation of riprap, dikes/levees and associated fill as a priority target for restoring natural floodplain and estuarine processes.
- Project reestablishes full floodplain function and access to historic off-channel habitats.
- Riparian vegetation is reestablished.
- Natural dendritic channels or surface water patterns are reestablished to avoid potential stranding of salmon.
- Hydrology is restored to estuarine or freshwater wetlands behind dikes.

Mass Wasting

Description:
In-channel projects that address geologic processes such as deep-seated slope failures, toe erosion, or landslides.

Benefits to salmon are increased if:
- Watershed assessment has identified the need to address specific in-channel habitat-forming processes to improve salmon habitat and productivity, and the project will be designed and implemented to address the cause.
- Assessment has been completed to insure that potential adverse impacts to other habitat-forming processes are identified and understood.

Roughened Channel

Description:
Projects that increase coarseness and texture in the stream channel using natural stream bed materials to reduce water velocity and facilitate salmon passage.

Benefits to salmon are increased if:
- Upstream hydrology and sediment processes are relatively intact.
- There is an adequate understanding of habitat-forming processes to ensure the project will remain functional over time.
- Floodplain conditions allow lateral channel movement, LWD deposition/accumulation, and increase in channel complexity.

Spawning Gravel Placement

Description:
Introduction of appropriate salmon spawning substrate to the channel, including bed control structures.

Benefits to salmon are increased if:
- Project is located out of normal floodplain and has a groundwater source.
- Fine sediment sources are limited or being addressed.
- Instream flow is adequate to transport fine sediment through project.
- Upstream hydrology and sediment processes are relatively intact and within the natural range of variation.
- There is an adequate understanding of habitat-forming processes to ensure the project will remain functional over time.

Wetland Restoration

Description:
The reestablishment of natural or more natural habitat-forming processes within historic freshwater and estuarine wetland areas.

Benefits to salmon are increased if:
- Watershed assessment has identified wetland degradation as a core element in the alteration of habitat-forming processes in the sub-watershed.
- If reestablishment of terrestrial or submerged aquatic vegetation is needed, native species must be used.
- Upstream watershed hydrology is relatively stable.
- Groundwater inputs to wetland are assessed and, when significant, within a natural range of variability.
- Project addresses the spatial and temporal habitat needs of identified salmon life stages.
- Upstream sediment processes are within the natural range of variability.
- Future land use change upstream of site will not degrade habitat processes.
- Perpetual easement is acquired to ensure long-term benefit.

Woody Debris Placement

Description:
Placement of woody debris in smaller stream channels or riparian areas to provide increased channel complexity, retain gravels, increase the quality and frequency of pool habitats, and provide cover for salmon.

Benefits to salmon are increased if:
- Watershed assessment has identified the need for the placement of LWD to satisfy short-term habitat requirements for salmon, while habitat-forming processes are being restored.
- Upstream hydrology and sediment processes are relatively stable and within the natural range of variability.
- Downstream channel is relatively stable.
- Riparian area deficiencies that limit natural LWD supply and delivery are being addressed.
- Future land use change upstream of site will not alter restoration of habitat-forming processes.
- Project is designed and performed by experienced design and construction personnel.
- LWD size and placement mimics natural accumulations functioning in the channel or in the reference reach.

RIPARIAN HABITAT

RIPARIAN HABITAT includes those freshwater and estuarine projects that will improve riparian habitat above the ordinary high water mark or in wetlands. Items may include plant establishment, removal, or management; livestock; fencing; stream crossing; and water supply.

Livestock Fencing/Crossing

Description:
Installation and maintenance of fencing or a "fish friendly" (non-barrier) stream crossing structure (e.g., bridge) to prevent livestock access to the stream and riparian zone.

Benefits to salmon are increased if:
- Watershed assessment has been completed, identifying livestock grazing as a primary cause of riparian loss and/or stream channel degradation in the sub-watershed.
- Project includes native riparian vegetation plantings where natural native plant presence is reduced or lost.
- Fenced riparian width is adequate to provide full riparian function; riparian width should include the channel migration zone, where applicable.
- Livestock watering sources are provided outside of the riparian zone.
- Agreement is developed or perpetual easement is acquired to ensure long-term protection that addresses both length of protection and allowable activities in the riparian area.

Riparian Vegetation Planting

Description:
Planting native riparian trees and shrubs in areas of the riparian zone that have been cleared for more intensive land uses to restore natural habitat-forming processes (delivery and routing of water, sediments, nutrients, wood, and heat).

Benefits to salmon are increased if:
- Watershed assessment has identified riparian deforestation as a primary cause of changes to habitat-forming processes in the sub-watershed.
- Native species are used in revegetation, including conifers where appropriate.
- Riparian plantings are staged to establish early successional trees/shrubs first; late successional species added after growing conditions for them are established.
- Riparian width is adequate to provide full riparian function; riparian width should include the channel migration zone, where applicable.
- Surficial aquifer associated with alluvial deposits of the stream floodplain is being maintained at levels that can support riparian reestablishment.
- Perpetual easement is acquired to ensure long-term benefit.

Plant Thinning, Removal, and Control

Description:
Selective thinning, removal, or pruning of non-native, and/or invasive vegetation on a site for the purpose of restoring the site as salmon habitat.

Benefits to salmon are increased if:
- Watershed assessment has identified delivery and routing of wood as a priority process in need of restoration in the sub-watershed.
- Native species are used in revegetation.
- Riparian width is adequate to provide full riparian function; riparian width should include the channel migration zone, where applicable.
- Perpetual easement is acquired to ensure long-term benefit (LWD recruitment is realized).

UPLAND HABITAT

UPLAND HABITAT includes those projects or land use activities that improve water quality and quantity important to salmon, but occur above the riparian or estuarine area. Considerations include timing and delivery of water to the stream; sediment and water temperature control; plant removal, control, and management; and water supply.

Road Abandonment/Decommissioning

Description:
Removal of roads that are vulnerable to failure due to design or location in relation to unstable soils, and cause sedimentation to a water body.

Benefits to salmon are increased if:

- Watershed assessment has identified roads as a primary source of sediment and habitat degradation in the sub-watershed.
- Road decommissioning restores natural drainage across the prior road corridor.
- All disturbed soil is revegetated with native species.
- Project complies with current USFS/DNR standards and criteria for road decommissioning.
- Project is conducted by experienced construction crew.

Road Erosion Control

Description:
Management actions implemented to reduce risk of sedimentation from surface erosion from roads or the risk of road failure and resulting mass wasting events.

Benefits to salmon are increased if:

- Watershed assessment has identified forest roads as a primary source of sediment and habitat degradation in the sub-watershed.
- All surface water collected in road ditches is redirected as subsurface flow on the down-slope side of the road.
- Project complies with current USFS/DNR standards and criteria for road storm-proofing.

Stormwater Attenuation

Description:
Detention, treatment, and infiltration of surface water runoff from impervious surfaces (e.g., roads, buildings, parking lots), to restore and maintain natural hydrology in the sub-watershed.

Benefits to salmon are increased if:

- Watershed assessment has identified runoff from impervious surfaces as a primary cause of hydrologic and nutrient process alteration in the sub-watershed.
- Stormwater attenuation approximates natural rates of surface water and groundwater delivery to the stream channel.
- Project complies with ECY stormwater guidelines and best management practices for western Washington.

ESTUARINE/MARINE NEARSHORE

ESTUARIAN/MARINE NEARSHORE HABITAT includes those projects that enhance fish habitat. Projects include work conducted in or adjacent to the intertidal area and in subtidal areas. Projects may include dike breaching, estuary planting, shoreline restoration, and tidal channel reconstruction.

Dike Breaching/Removal

Description:
Removing or breaking through all or part of a man-made dike to restore natural tidal exchange in an historical estuarine environment like a river delta.

Benefits to salmon are increased if:

- Removal/breaching provides access to habitat historically used by salmon and prey species.
- Natural tidal regime is reestablished.
- Unimpeded access and egress is provided.

Estuary Planting

Description:
Planting or restoring native estuarine or marine vegetation to improve fish habitat, including eel grass bed or kelp forest reestablishment.

Benefits to salmon are increased if:

- Watershed assessment and/or shoreline inventories identify loss of eel grass or kelp as a limiting factor.
- Water quality and sediment influx to the estuary are adequate to support reintroduction of marine vegetation.
- Plantings are within areas known to support eel grass or kelp forests in the past.
- Project location is away from jetties or other artificial structures that provide habitat for fish species that prey on salmon.

Shoreline Restoration

Description:
Reestablishment of natural or more natural delivery and routing of beach sediment, retention of detritus and nutrients in the nearshore area, restore benthic production, and restore baitfish spawning areas. Includes removing contamination or structures/bulkheads, removing invasive or non-native vegetation, and planting native vegetation.

Benefits to salmon are increased if:
- Watershed assessment has identified alterations in the delivery and routing of nearshore sediments as a core factor in the loss or degradation of nearshore habitat.
- Project reestablishes native plant species in the nearshore riparian zone.
- Project is consistent with assessment work that identifies jetties, bulkheads, and other structures having the greatest effect on the delivery of sediment to the nearshore area and the routing of that sediment through the drift cell.

Tidal Channel Reconstruction

Description:
Reconstruction or restoration of tidal channels removed from the confluence of a river delta and estuarine system.

Benefits to salmon are increased if:
- Natural tidal prism and flushing can be re-established.
- Sediment influx to tidal channels is within the natural range of variability for the watershed.
- Hydrologic regime is within the natural range of variability for the watershed.
- Project location is away from artificial structures that provide habitat for fish species that prey on salmon.

Tide Gate Removal

Description:
Removal of tide gate(s) and restoration of natural tidal flushing within the estuarine environment.

Benefits to salmon are increased if:
- Unimpeded fish access can be reestablished.
- Habitat provides the necessary life history needs for rearing salmon and their prey species.
- Habitat-forming processes that maintain habitat are functioning adequately.

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Glossary

Adaptive management: designing monitoring and assessing progress toward meeting objectives and incorporating what is learned into future management decisions.

Channel complexity: describes salmon habitat. A comp lex channel contains a mixture of habitat types that provide areas with different velocity and depth for use by different salmon life stages. In contrast, a simple channel contains more uniform flow and few habitat types.

Char: close relatives to trout and salmon. Bull trout are a species of char.

Connectivity: the physical connection among and between tributaries and a river, between surface water and groundwater, and between wetlands and these water sources.

Conservation: includes protection, maintenance, and restoration of habitat characteristics to support the species of interest.

Disturbance: events that affect landscapes, from regions (and watersheds) to sites. They include floods, wildfires, landslides, and volcanoes. They may vary in intensity from small-scale to catastrophic, and in frequency from a few years to many decades or hundreds of years. Natural disturbance regime is the regime that occurred historically.

Ecosystem Diagnosis and Treatment (EDT): is a method that uses a "rule-based" system that focuses on habitat as the unit of analysis, and estimates salmon performance by using an analytical model that predicts the numbers of fish supported by the habitat over the salmon's life history. It is an "expert system" that captures the state of existing knowledge including areas of incomplete or missing data.

Estuary: the area where fresh and saltwater mix at the mouth of a river.

Fishway: passageway, often an ascending series of pools, designed to permit passage of salmon over dams, diversions, or other obstructions.

Floodplain: the low area adjoining a stream or river channel that overflows at times of high river flow.

Flow/hydrology: includes several components of the natural flow regime of streams and rivers, such as: volume is the amount of surface flow; frequency is how often a flow above a given magnitude recurs; duration is the period of time a specific flow condition persists; timing is the regularity or consistency of specific flow conditions; and rate of change is how quickly amount of flow increases or decreases. All of these components are important to the ecological integrity of rivers, streams, adjacent floodplains, and estuaries.

Habitat access: unobstructed upstream and downstream movement of fish of all life stages.

Habitat capacity: the maximum average number or biomass of salmon that can be sustained in a habitat over the long term.

Habitat-forming processes: physical agents of landscape pattern formation and maintenance (i.e., the natural rates of delivery of water, sediment, heat, organic materials, nutrients, and other dissolved materials).

Historic: conditions prior to pre-European settlement. Actual data on those conditions are generally limited, but retrospective analyses can lead to reconstruction and estimation of those conditions.

Hydrology: see Flow/hydrology.

Impervious surface: surface (such as pavement) that does not allow, or greatly decreases, the amount of infiltration of precipitation into the ground.

Large woody debris (LWD): typically is defined as any piece of woody material 12 inches or larger in diameter, that intrudes into a stream channel or nearby (e.g., logs, stumps, or root wads). LWD functions to form pools, regulate sediments, disperse stream energy, create channel complexity, stabilize channels, provide instream organic matter, and provide cover for fish.

Limiting factors: defined in the context of the Salmon Recovery Act (ESHB 2496) as "conditions that limit the ability of habitat to fully sustain populations of salmon."

Marine nearshore areas: include intertidal estuarine and marine areas, shallow subtidal areas, supratidal areas (the area directly adjacent to marine influenced areas), and tidally-influenced portions of rivers and streams (e.g., deltas, river mouths). Some characteristic nearshore habitats include marshes, wetlands, tidal channels and sloughs, mudflats and sandflats, seaweed beds, seagrass meadows, kelp forests, unvegetated rocky or sandy beaches, riparian forests, and the water column itself.

Mass wasting: down-slope transport of soil and rocks due to gravitational stress.

Model: in general, models are conceptual and mathematical descriptions or analogies used to help visualize something that cannot be directly observed. They provide frameworks that organize concepts and information/data into a system of inferences that can be presented as mathematical descriptions of situations or state of affairs.

Off-channel habitat: ponds, oxbows, sloughs, and other backwater areas with cover that provide high-quality rearing habitat for juvenile salmon.

Preservation: generally refers to acquisition of existing habitat for the purposes of conservation.

Production: the type and quantity or biomass of an organism; for salmon, often expressed as numbers or weight of juveniles, smolts or adults.

Productivity: the ability of a biological system or a given area to produce biological matter (e.g., salmon); refers to the efficiency with which a biological system converts energy into growth and reproduction.

Region: salmon recovery region as defined in the *Statewide Strategy to Recovery Salmon "Extinction is Not an Option"* (1999).

Restoration: reestablishing the structure and habitat-forming processes of an watershed/ecosystem.

Salmon strongholds or refugia: areas where salmon populations are healthy and habitat exists to maintain that healthy status.

Reach: a defined section of a river or stream channel.

Riparian areas: are located between a stream or other water body and the adjacent upland, including wet areas of floodplains and valley bottoms.

Riparian vegetation: vegetation growing on or near the banks of a stream or other body of water in soils that are wet during some portion of the growing season, including areas in and near wetlands, floodplains, and valley bottoms.

Salmon: all species of salmon, steelhead, trout, and char native to Washington.

Site: specific locations where on-the-ground restoration projects occur.

Stock: fish spawning in a particular lake or stream(s) at a particular season, which to a substantial degree do not interbreed with any group spawning in a different place at the same time, or in the same place at a different time.

Sub-watershed: geographic drainage units that combine to form a larger watershed.

Water Resource Inventory Area (WRIA): watershed areas administratively defined in RCW Chapter 173-500-040. Within area boundaries, all surface freshwater and adjacent estuaries and marine areas are included.

Watershed: area of land that water flows across or under on its way to a river, lake, or ocean.

Watershed assessment: a scientifically-based approach to understanding how a watershed works; technical efforts that describe ecological processes, potentials, functions, and conditions at multiple spatial and temporal scales, to identify and analyze causes and effects after a period of change.

Weir: a device across a stream to raise the water level or divert its flow.

Acronyms

CRI	Cumulative Risk Initiative
DNR	Washington Department of Natural Resources
ECY	Washington Department of Ecology
EDT	Ecosystem Diagnosis and Treatment
ELJ	Engineered Log Jam
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESHB	Engrossed Substitute House Bill
FOTG	Field Office Technical Guideline
FPB	Forest Practice Board
GIS	Geographic Information System
GMA	Growth Management Act
LFA	Limiting Factors Analysis
LWD	Large Woody Debris
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
NWFSC	Northwest Fisheries Science Center
NWPPC	Northwest Power Planning Council
RCW	Revised Code of Washington
SaSI	Salmonid Stock Inventory
SMP	Shoreline Master Program
SSHEAR	Salmonid Screening, Habitat Enhancement and Restoration
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment Project
TFW	Timber Fish and Wildlife
TMDL	Total Maximum Daily Load
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation

Suggested References

The following list contains references cited in the ***Guidance on Watershed Assessment for Salmon***. It also includes other references that provide additional information on the concepts and approaches associated with the ***Guidance***.

Beamer, E. T. Beechie, B. Perkowski, and J. Klochak. 2000. Application of the Skagit Watershed Council'' strategy, river basin analysis of the Skagit and Samish Basins: tools for salmon habitat restoration and protection. Working Document, February 2000, Skagit Watershed Council. 80 pp.

Beechie, T. and S. Boulton. 1999. An approach to restoring salmonid habitat-forming processes in Pacific Northwest watersheds. Fisheries 24(4): 6-15.

Collins, B.D. 2000. Mid-19th century stream channels and wetlands interpreted from archival sources for three north Puget Sound estuaries. Report to Skagit system Cooperative, Bullitt Foundation, and Skagit Watershed Council. Department of Geological Sciences, University of Washington, Seattle. 65 pp.

Independent Scientific Advisory Board. 2001. Model synthesis report: an analysis of decision support tools used in Columbia River Basin salmon management. ISAB 2000-1, Northwest Power Planning Council and National Marine Fisheries Service, Portland, OR. NWPPC website: http://www.nwcouncil.org/library/isab/index.htm

Joint Natural Resources Cabinet. 1999. Statewide Strategy to Recover Salmon: Extinction is Not an Option. Governor's Salmon Recovery Office, Olympia, WA. 324 pp.

Kauffman, J.B., R.L. Beschta, N. Otting, and D. Lytjen. 1997. An ecological perspective of riparian ecosystem management. Fisheries 22(5): 12-24.

Lestelle, L.C., L.E. Mobrand, J.A. Lichatowich, and T.S. Vogel. 1996. Applied ecosystem analysis - a primer, EDT: the ecosystem diagnosis and treatment method. Project number 9404600. Bonneville Power Administration, Portland, Oregon.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. NOAA Technical Memorandum NMFS-NWFSC-42. Northwest Fisheries Science Center, Seattle. 161 pp.

Mobrand Biometrics, Inc. 1999. The EDT (Ecosystem Diagnosis and Treatment) method. Draft report. 38pp.

Montgomery, D.R., and J.M. Buffington. 1993. Channel classification, prediction of channel response, and assessment of channel condition. Washington Department of Natural Resources Report TFW-SH10-93-002. 84 pp.

Montgomery, D.R., G. Grant, and K. Sullivan. 1995. Watershed analysis as a framework for implementing ecosystem management. Water Resources Bulletin 31(3): 369-386.

Naiman, R.J. T. Beechie, L. Benda, D. Berg, P. Bisson, L. McDonald, M. O'Connor, P. Olson, and E. Steel. 1992. Fundamental elements of ecologically healthy watersheds in the Pacific Northwest coastal ecosystem. In: Naiman ed. Watershed Management. Springer-Verlag. p. 127-188.

National Marine Fisheries Service. 1996. Coastal salmon conservation: working guidance for comprehensive salmon restoration initiatives on the Pacific Coast. NMFS website: http://www.nwr.noaa.gov/1salmon/salmesa/pubs/salmrest.pdf

Northwest Power Planning Council. 2000. Subbasin assessment template for the Northwest Power Planning Council's Fish and Wildlife Program. Final draft June 6, 2000.

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, OR. 356 pp.

U.S. Department of Agriculture. 1994. A Federal agency guide for pilot watershed analysis. Version 1.2 US Forest Service. 49 pp.

Washington Forest Practices Board. 1997. Standard methodology for conducting watershed analysis. Version 4.0 Washington Department of Natural Resources. 112 pp.

Washington Department of Ecology. 1999. Process-based river basin characterization: a case study, Snohomish Basin, Washington. First draft June 1999. Olympia, WA.

Washington Department of Fisheries, Washington Department of Wildlife, and Western Washington Treaty Indian Tribes. 1993. 1992 Washington State Salmon and Steelhead Stock Inventory (SASSI). Washington Department of Fish and Wildlife, Olympia. 212 pp.

Washington Department of Fish and Wildlife. 1998. Washington State Salmonid Stock Inventory (SaSI): Bull trout and Dolly Varden. Washington Department of Fish and Wildlife, Olympia. 437 pp.

Washington State Conservation Commission – Limiting Factors Analysis reports can be ordered online from: http://www.conserver.org/salmon/reports/index.shtml

Appendix 1

Assessment Stages and their Relationships to Existing Statewide Information Sources

Assessment Stages and Questions	Suggested Sources of Data, Information[1], and Analysis	Relationship to Existing Assessments/Resources to Use
Stage I-- Habitat Conditions		
Describing the Watershed - What are the important or relevant features of the watershed? - What are the current conditions? - How do conditions diverge from what is expected of a healthy watershed? - What habitat conditions limit salmon production?	*Information*: geologic, climatic, topographic, hydrologic, water quality, water use/diversion, groundwater recharge areas, sediment loads, channel classification and conditions, artificial barriers, road density, landslides, wetlands, floodplain, estuaries and nearshore conditions, and land cover/land use. *Sources:* USGS, Environmental Protection Agency (EPA), NMFS, ECY, WDFW, DNR, NWIFC, local watershed plans, LFAs, SSHIAP, GIS data sets covering regional hydrography; regional groundwater flow; topography/digital elevation model data; 303 (d) water quality data; dam inventory; SSHEAR fish passage barriers and unscreened diversions inventories, shoreline, wetlands, estuaries and nearshore inventories; and current and pre-development aerial photographs/maps.	- LFAs (including description of marine and near-shore characteristics. - Watershed assessment under the Watershed Planning Act 1998 (ESHB 2514) or other processes (watershed assessments may identify outside influences that affect water availability within the watershed). - SSHIAP database (expansion of SSHIAP will include GIS coverages that depict the watersheds components such as geology, and land cover/use). - SSHIAP expansion will also include estuarine-marine nearshore habitat. - NWPPC sub-basin assessments for the Columbia Basin. - Forest Practices Board (FPB)/DNR Watershed Analyses completed for use in regulating forest practices on state and private lands.
Describing Stock Status and Trends - What are the species and stocks in the watershed, and where are they located? - What is the historic and current abundance and distribution of salmon in the watershed? - How do different life histories contribute to diversity and distribution of stocks?	*Information:* Known salmonid species and stocks, stocks distribution and population levels (if available), life history patterns, and species interaction. *Sources:* Various information is available from LFA, SaSI, NMFS and USFWS data and technical documents (e.g., technical recovery documents). SSHIAP, State/Tribal spawner escapement and run reconstruction data and technical studies and university publications.	- LFAs provide the best available information on salmon distribution, and one of the best discussions of historic and current status of salmon. - SaSI is in process of being updated making it the most up-to-date source of stock information. - NMFS/USFWS technical recovery documents are expected to provide information. - On-going state/tribal stock assessment programs.

[1] There are many sources beyond what are mentioned in this table. Information also varies by geographic area and topic.

Assessment Stages and Questions	Suggested Sources of Data, Information[1], and Analysis	Relationship to Existing Assessments/Resources to Use
Stage I Synthesis: - What is the extent and nature of human-caused factors affecting salmon habitat productivity in the watershed? - At what (freshwater or estuarine) life history stage do habitat conditions have the greatest effect? - What preservation and restoration actions are critical to improve salmon productivity?	GIS mapping	- LFAs describe watershed and salmon stock conditions. They identify and rate (poor, fair, and good) habitat factors (focusing on 14 factors) limiting salmon performance by sub-watershed. LFAs include recommendations for habitat preservation and restoration actions and data gaps. - Watershed assessment under the Watershed Planning Act 1998 (ESHB 2514) identify low flow conditions, and their impacts on salmon, instream flow needs of salmon and actions needed to put water back in streams for fish. - EDT model provides details on habitat conditions by stream reach and maps life history across the landscape. The information is generated using existing data and expert judgment. - NWPPC sub-basin summaries completed to date have products similar to LFAs. The summaries are used with EDT to evaluate management scenarios. - FPB/DNR Watershed Analyses provide information on current and potential watershed conditions, watershed scale perspective of cause and effects linkages and areas requiring forest practices prescriptions.

Assessment Stages and Questions	Suggested Sources of Data, Information[1], and Analysis	Relationship to Existing Assessments/Resources to Use
Stage II –Causes of Habitat Conditions		
Describing changes to habitat-forming Processes - What are the most important habitat-forming processes in the watershed that are responsible for creating and maintaining habitat for salmon? - How have these processes changed from the past? - What is likely to change in the future and where? - Where should sub-watershed processes be further assessed?	*Data and information:* sediment budget and sediment change modeling; landslide assessments, hydrology change modeling and water budget; nutrient budget and nutrient change modeling; organic and large woody debris change modeling; riparian assessment and landscape temperature at the watershed-scale. Historic data on frequency, extent and duration of fire, wind, floods, and other natural disturbance factors in the watershed. Current and projected future land use/land cover and information compiled on the type, extent and duration of disturbances in the watershed (e.g., flow diversions). *Sources:* LFA may provide some information; State and federal (e.g., USFS, DNR, Natural Resource Conservation Service (NRCS), ECY) watershed analysis; USGS studies; state and federal land use /land cover data; FPB/DNR Watershed Analyses; NMFS technical studies; Counties' Growth Management Act (GMA) and Shoreline Master Program (SMP) plans; publications and technical documents from agencies, universities and private landowners; regional and/or state historical references.	- Except for few watersheds (e.g. Skagit, Snohomish) current assessments do not include comprehensive discussion or approach to habitat-forming processes. - Watershed assessment under the Watershed Planning Act 1998 (ESHB 2514) can provide understanding of how natural and human-caused factors affect water resources. - LFAs identify relative levels of disturbance in sub-watersheds, and habitat-forming processes when the information is readily available, but they do not assess or analyze the processes to understand the core causes of existing habitat conditions and likely changes in the future. - SSHIAP GIS coverage and historic habitat conditions can help depict change in habitat, not processes. - FPB/DNR Watershed Analyses identify watershed processes (sediment, water, wood and energy) and relate them to stream environment and conditions.
Stage II Synthesis - What processes have been altered and where? - Which sub-watersheds (and the areas within them) have the greatest potential for contributing to overall salmon recovery in the watershed? - Which of those sub-watersheds are most threatened by potential future development?	GIS mapping, analysis, and modeling	See above

Assessment Stages and Questions	Suggested Sources of Data, Information[1], and Analysis	Relationship to Existing Assessments/Resources to Use
Stage III—Salmon Response		
<u>*Defining Salmon Life History and Habitat Relationships*</u> - What are the linkages between habitat and fish productivity? - What life stages are most limited by altered habitat condition, and where? - What sub-watersheds or areas within the sub-watersheds, and specific habitats are most important to one or more salmon life stage, now and likely in the future?	<u>*Information:*</u> See stages I and II information on habitat conditions, stock status and trends and habitat forming processes. At this Stage, information is needed from riparian condition inventories, sediment supply inventories (landslides and roads), fish passage inventories (culverts, dikes, dams, etc.), Floodplain function inventories (diking, dredging, channelization), hydrologic condition inventories (e.g. amount of impervious surface), known water quality problems (303 d list, temperature, dissolved oxygen, turbidity, etc.), LWD surveys <u>*Sources:*</u> Field studies, analysis and modeling (for example modeling to determine density and survival of salmon for different habitat classification); university publications; NMFS and USFWS data and technical documents (CRI and other technical recovery documents); WDFW and Tribes smolt assessments (count and linkages to habitat); WDFW/ECY freshwater Productivity Research. Some information is available from LFAs, DNR Watershed Analysis, and EDT.	- This stage relies on experiments, field observations, monitoring data, predictive modeling, and use of adaptive management. Approaches to modeling are rapidly evolving. - Some work is being done by NMFS, WDFW, Tribes in collaboration with the universities and other state and federal agencies.
<u>*Synthesis:*</u> - What are the relationships between salmon populations and habitat types and conditions? - Where should recovery efforts be focused in the watershed? - What actions will contribute the most to salmon productivity in the watershed?	GIS mapping, analysis, and modeling	See above

APPENDIX 2

Technical Guidelines[1] Specific to Categories of Habitat Restoration Projects Listed in Part III

Categories of Projects	Current Technical Guidelines	Technical Guidelines In Development	Comment & Reference
Acquisition			
Acquisition by Fee Ownership			- Not Applicable
Acquisition of Water Rights			- Not Applicable
Acquisition of Utilization or Access Rights			- Not Applicable
Instream Diversion			
Fish By-pass/Fish Screen	- NMFS' Juvenile Fish Screening Criteria	- Draft Fish Protection Screen Guidelines	- NMFS-1996 - WDFW, in negotiation with NMFS, final expected by 6/01
Instream Passage			
Bridge			
Culvert Improvements	- Fish Passage Design at Road Culverts		- WDFW www.wa.gov/wdfw/hab/engineer/habeng.htm
Dam Removal	- Dam Safety Guidelines		- ECY Dam Safety - www.ecy.wa.gov
Diversion Dam	- Upstream Fish Passage at Dams - Dam Safety Guidelines	- Fishways Design, Operation, and Evaluation - Draft Fish Protection Screen Guidelines	- WDFW, in negotiation with NMFS, finals expected by 6/01 www.wa.gov/wdfw/hab/engineer/habeng.htm - ECY Dam Safety - www.ecy.wa.gov
Fishway and Log/Rock Control Weirs		- Guiding Principles for Channel Design- Guidelines expected by 2002	- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide/salguide.htm

[1] Technical Guidelines are limited to project design, construction and operation in, near, or affecting aquatic systems. Some guidelines are completed. Others are currently being developed consistent with a set of guiding principles or general statements outlining the ecological basis for the technical guidelines.

Categories of Projects	Current Technical Guidelines	Technical Guidelines In Development	Comment & Reference
Instream Habitat			
Bank Stabilization	- Integrated Streambank Protection Guidelines		- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide/salguide.htm
Carcass Placement	- Fish Health Guidelines and Protocols for Carcass Distribution		- WDFW
Channel Complexity and Off-channel Habitat		- Guiding Principles for Channel Design- Guidelines expected by 2002	- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide/salguide.htm
Channel Configuration		- Guiding Principles for Channel Design- Guidelines expected by 2002	- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide/salguide.htm
Complex Log Jams		- Guiding Principles for Channel Design- Guidelines expected by 2002	- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide/salguide.htm
Dike Removal or Set Back		- Guiding Principles for Channel Design- Guidelines expected by 2002	- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide/salguide.htm
Mass Wasting	- Forest Practices Rules and FPB - Guide to Surface Water and Groundwater on Coastal Bluffs		- DNR & FPB - ECY - www.ecy.wa.gov
Roughened Channel		- Guiding Principles for Channel Design- Guidelines expected by 2002	- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide/salguide.htm
Spawning Gravel Placement		- Guiding Principles for Channel Design- Guidelines expected by 2002	- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide/salguide.htm
Wetland Restoration	- Restoring Wetlands at a River Basin Scale: A Guide for Washington's Puget		- ECY - www.ecy.wa.gov

Categories of Projects	Current Technical Guidelines	Technical Guidelines In Development	Comment & Reference
	Sound		
Woody Debris Placement	- Forest Practices Rules and FPB Manual	- Guiding Principles for Channel Design - Guidelines expected by 2002	- DNR & FPB - WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide/salguide.htm
Riparian Habitat			
Livestock Fencing/Crossing	- NRCS Practices Standards and Specifications (or Field Office Technical Guideline (FOTG)) for Washington State		- NRCS-Section 4 of the FOTG[2] www.wa.nrcs.gov/FOTG/INDEX.html
Riparian Vegetation Planting	- Integrated Streambank Protection Guidelines - Guide to Surface Water and Groundwater on Coastal Bluffs		- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide/salguide.htm - ECY - www.ecy.wa.gov
Plant Thinning, Removal, and Control	- Integrated Streambank Protection Guidelines		- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide/salguide.htm
Upland Habitat			
Road Abandonment and Decommissioning	- Forest Practices Rules and FPB Manual		- DNR & FPB
Road Erosion Control	- Forest Practices Rules and FPB Manual		- DNR & FPB
Stormwater Attenuation		- Stormwater Management Manual for Western Washington – expected adoption 2001.	- ECY

[2] The NRCS Field Office Technical Guidelines contains a list of conservation practices and detailed guidelines on practice standards and specifications. The practices standards establish the minimum level for planning, designing, installing, operating and maintaining conservation practices such as channel vegetation, floodwater diversion, and wetland restoration.

Categories of Projects	Current Technical Guidelines	Technical Guidelines In Development	Comment & Reference
Estuarine and Nearshore Marine			
Dike Breaching/Removal		- Guiding Principles for Channel Design- Guidelines expected by 2002	- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide.htm
Estuary Planting/Eel Grass bed or Kelp Forest Reestablishment			- Not available
Shoreline Restoration	- Integrated Streambank Protection Guidelines		- WDFW/WSDOT/ECY- Aquatic Habitat Guidelines www.wa.gov/wdfw/hab/salguide.htm
Tidal Channel Reconstruction			- Not available
Tide Gate Removal			

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