HCD Stormwater Online Guidance

ESA Guidance for Analyzing Stormwater Effects

NOAA Fisheries Service
Northwest Region
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I. Introduction

a) Purpose - Guidance for Making Effect Determinations

This stormwater guidance is designed to assist NOAA Fisheries HCD staff (and after further refinement, project applicants) in making effects determinations during Section 7 consultations and in analyzing effects when using other ESA mechanisms (i.e. Section 4(d) limits or Section 10 conservation plans). The primary tool presented in the guidance is a dichotomous key which guides staff through a series of questions to arrive at an effects determination for projects or programs with stormwater effects. This guidance is based on the best science and commercial data available.

This is internal guidance to NOAA Staff that provides a default analytical framework for analyzing stormwater effects. The application of this guidance is not mandatory upon staff nor external customers. Just as with other guidance documents we use, NOAA Fisheries will accept scientifically credible alternative frameworks. This guidance may be used outright for routine applications, or may serve as supporting information for NOAA Fisheries staff in discussions with customers developing ESA work products.

The guidelines are designed to facilitate consistent determinations of effect for conferencing, consultations and permits focusing on anadromous salmonids where the proposed action has the potential to affect habitat conditions in the transitional and lowland segments of rivers and streams (i.e, downstream of the headwaters) in the Pacific Northwest, where proposed actions or programs will likely result in effects to hydrology and water quality as a result of stormwater runoff. Projects that propose land conversions, such as forest to pasture, or rural to urban land uses, are best suited for this guidance. The guidance will also work when analyzing the effects of redevelopment or urban/rural development in headwater reaches.

The primary tool presented here is a dichotomous key (section II). The key was designed to guide NOAA Fisheries staff through a series of questions to arrive at the effects determination for a proposed action or program with effects due to stormwater runoff. The key can also be used by staff in analyzing effects in the Section 4(d) and Section 10 processes. This guidance is based on the best science and commercial data available (as synthesized in Appendix A). For many projects, other analyses will be necessary to determine the project effects due to other causes (e.g., loss of shallow water habitat).

b) Scientific Background

The development of urban areas has resulted in a number of documented effects on physical, chemical, biological and ecological properties of streams ecosystems. Of most concern, are the long term effects on stream hydrology, geomorphology, and water quality. Salmon need cold, clean water and annual and daily hydrologic patterns adequate to support stream geomorphology, and habitat structure and complexity. A summary of the effects can be found in a recent review of the literature from studies in North America and Europe by Paul and Meyer

(2001), and more locally in the Pacific Northwest in an article by May et al. (1997). This research documents the most consistent and pervasive effect of urbanization is an increase in impervious surface cover, which alters the hydrology and geomorphology of streams, and causes predictable changes in stream habitat and water quality. While the focus of the research tends to be on urban systems because the effects of land conversion to urban uses have had the greatest impact on hydrology and water quality, the same processes apply to any subwatershed experiencing some type of land conversion. In the forested environment in the Puget Sound area, almost half of all rainfall returns to the atmosphere via evapotranspiration (Beyerlein 1999). As land use changes to rural, and then to urban, evapotranspiration declines sharply and surface runoff from most soil types increases (Figure 1). Up to 40% loss in infiltration to groundwater has been measured in watersheds with land use changes (Paul and Meyer 2001). The changes in hydrology are strongly correlated to the loss of forest cover and increase in impervious surface (Booth et al. 2001). Runoff from urban surfaces as well as municipal and industrial discharges result in increased loading of nutrients, bacteria, metals, pesticides, and other toxicants to streams (Porcella and Sorenson 1980, Lenat and Crawford 1994, Latimer and Quinn 1988, USGS 1999a and b). Other observed effects of increased stormwater runoff that affect stream quality are: increased frequency and severity of flooding, accelerated channel erosion, alteration of streambed substrate size composition, reduced base flow, alteration of energy inputs to streams, and alteration of the natural temperature regime (Klein 1979). These effects are exacerbated by the loss of riparian forests and floodplains. The physical and chemical changes result in declines in healthy microbial and invertebrate communities (Horner et al. 1997) and a reduction in fish diversity (Wang et al. 1997), including vulnerable cold-water species like salmon.

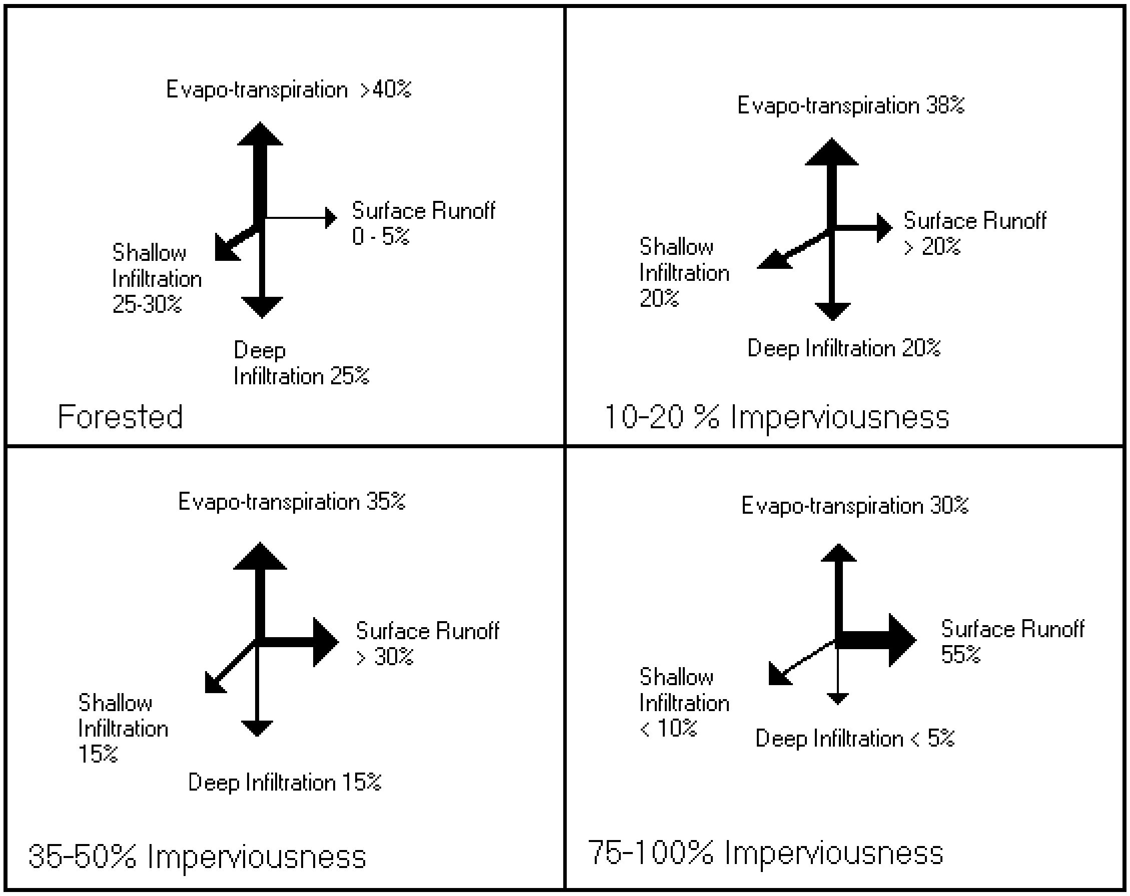

Figure 1. Changes in hydrologic flows with increasing impervious surface cover in urbanizing subwatersheds (Adapted from Arnold & Gibbons 1996 and from Beyerlein 1999).

While the effects described above tend to be most acute in urban areas, subwatersheds in non-urban areas undergoing changes in land use and/or loss of forest cover also exhibit altered hydrology and geomorphology. Anytime tree cover is reduced and soils are altered, the amount evapotranspiration is reduced, the amount of surface runoff is dramatically increased, and the contribution to groundwater is reduced. This pattern is ubiquitous throughout North America and Europe, although the extent of the effect varies depending on physical, biological and chemical properties of the subwatershed.

A detailed discussion of how stormwater runoff affects the properties and processes of watersheds is provided in Appendix A. This appendix provides useful information for NOAA Fisheries staff in the development of the effects section of biological opinions. However, a primary purpose of this guidance is to identify necessary strategies designed to avoid or minimize the long term effects of stormwater runoff associated with development and construction.

c) Recommended Use of Guidance

The intended users of this guidance include NOAA Fisheries staff who are reviewing projects or programs for ESA compliance, and project proponents who are preparing documents and designing projects for submittal to NOAA Fisheries. We recommend that this guidance be applied to individual or grouped actions at the reach, subwatershed or watershed scale. It can also be used to evaluate municipal programs, also at the subwatershed or watershed scale.

The guidance was designed to be applied to a wide range of environmental conditions. As such the process is intended to be flexible, and professional judgement will be required in its application. There will be circumstances where the ranges of numerics or descriptions in the dichotomous key do not apply to, or are not readily available in, a specific watershed or subwatershed. In such a case, the evaluator will need to provide more biologically-appropriate values to substantiate the effects determination. Where values are not available, the best available science must be used. When this occurs, documentation justifying these changes should be presented in the biological assessment, habitat conservation plan, or other appropriate document presented by the applicant to NOAA Fisheries.

The data and information used to develop the dichotomous key (presented section II b) are primarily from studies in the Puget Lowlands, Willamette Valley, western Cascades and Coast Range. The degree to which the key would apply to projects in other geographic areas of Washington and Oregon, or in Idaho and California, is not known at this time. Hydrologic cycles differ regionally; the transient-snow zone of the mid-elevations of the Cascades and northern Sierra Nevadas experience high-flow events during the winter, the hydrographs of snow-dominated systems of the high Cascades, Sierra Nevadas, Blue Mountains and northern Rocky Mountains demonstrate low winter flows and high flows in late spring, and the arid and semi-arid regions east of the Cascades and Sierra Nevadas are characterized by infrequent rain during the warm periods of spring, summer and fall (Spence et al. 1996). Variation in the natural hydrology is common in river systems where flow is regulated either through dams or withdrawals. We anticipate that some adjustments would need to be made to the dichotomous key prior to implementation of this guidance when projects occur outside of the Puget Lowlands, Willamette Valley, western Cascades and Coast Range.

d) Project or Program Review

When NOAA Fisheries conducts an analysis of a proposed activity, project, or program, the evaluation includes the following steps: (1) Define the biological requirements of the listed species and gather information on fish use in the action area; (2) evaluate the relevance of the current environmental baseline to the species' current status; (3) determine the effects of the proposed or continuing action on listed species; and (4) determine whether the species can be expected to survive with an adequate potential for recovery under the effects, considering measures for survival and recovery specific to all life stages. Information necessary to complete step 1 can be obtained through NOAA Fisheries status reviews and local fish and wildlife biologists. Step 2 can be accomplished using a variety of tools including the draft Matrix of

Pathways and Indicators for lowland streams (draft MPI-Lowland) provided in Appendix B. This guidance provides a process for step 3, determining the effects of the proposed action. Step 4 addresses considerations given during a jeopardy analysis, using information gathered in steps 1-3.

a) Document Overview

The process for determining the effect of a proposed action or program is provided in section II of this guidance. The key presents a series of questions designed to identify and evaluate the potential effects of the proposed action on listed anadromous fish, and determine whether the action is likely to adversely affect the species. The effect of an action is determined based on the potential to affect the characteristics and processes important to support properly functioning subwatersheds or watersheds in areas undergoing some type of land conversion. Examples of hypothetical projects and activities for the three effect scenarios are also presented in section II.

Section IIIa of this guidance presents a menu of measures developed to avoid and minimize the effects of project construction or program implementation, and long-term operation. The best opportunity for the incorporation of these measures is during project or program development. The consequence of integrating these measures early into the project includes both environmental and procedural benefits. The environmental benefits are realized when project proponents take an integrated, watershed approach to protecting hydrologic processes that support anadromous fish. If incorporated into project/program design, the effect of the project/program can be minimized, possibly influencing the threshold level of effect, and streamlining the consultation or review process. Even if formal consultation is necessary, efficiencies are gained when the minimization and avoidance measures are incorporated early into a project, avoiding the need for late stage re-designs.

Section IIIb provides model terms and conditions that may be applied to proposed actions or programs that predict effects to hydrology and water quality as a result of stormwater runoff. Although written to be easily incorporated into Biological Opinions, these terms and conditions can also be used to minimize impacts of programs being evaluated in the Section 4(d) and 10 processes.

Five appendices provide supporting background information and additional tools to guide NOAA Fisheries staff in the development of biological opinions, or other section 4 or 10 permits. As mentioned above, Appendix A presents a detailed discussion of how stormwater runoff affects the properties and processes of watersheds (and subwatersheds).

The draft MPI-Lowland provided in Appendix B has been developed as an additional tool to analyze the effects of stormwater or urban development on lowland subwatersheds and watersheds (Appendix B). The draft MPI-Lowland should not be used as the primary tool to determine project-level or program-level effects. Instead it can be used to provide background and understanding of how stormwater and other effects in the lowland environment can be integrated. The draft MPI-Lowland reflects information needed to evaluate urban, suburban and agricultural effects on properly functioning conditions in lowland rivers and streams. The draft MPI-Lowland is a modification of a Matrix published in "*Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale*" (NOAA Fisheries, Northwest Region,1996), to analyze the effects of actions on forested Federal lands in the northwest. This 1996 Matrix uses pathways and indicators that are relevant to headwater, forested watersheds to describe the current environmental baseline of the watershed. The draft MPI-Lowland was fashioned after the original MPI, modified to include physical and biological properties more relevant to lowland rivers and streams and the biological and physical responses from the various baseline conditions associated with these landscapes. The draft MPI-Lowland is in draft form, and will likely be revised during the next year.

Information on regional differences in stormwater and state regulatory approaches to stormwater for Oregon, Washington, Idaho and California are presented in Appendix C. A glossary in Appendix D provides definitions for terms used in this document, and acronmyns used in this document are identified in Appendix E.

II. Effects Determination Process

a) Definitions of Effects Thresholds

No effect. This determination is only appropriate if there will be "literally no effect whatsoever" or "no probability of any effect" (*The Habitat Approach,* NOAA Fisheries, Northwest Region, 1999). If there are no proposed or listed salmon and no proposed or designated critical habitat in the action area or downstream from it, the action is determined to have "no effect". Furthermore, actions that result in a "beneficial effect" do not qualify as a no effect determination.

May affect, not likely to adversely affect. The appropriate conclusion when effects on the species or critical habitat are expected to be beneficial, discountable, or insignificant. The effect level is determined to be "may affect, not likely to adversely affect" if the proposed action does not have the potential to hinder attainment of relevant properly functioning indicators and has an extremely low probability of taking proposed or listed salmon or resulting in the destruction or adverse modification of their habitat (*The Habitat Approach,* NOAA Fisheries, Northwest Region, 1999). Beneficial effects have contemporaneous positive effects without any adverse effects to the species or habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgement, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur (*Endangered Species Consultation Handbook; Procedures for Conducting Section 7 Consultations and Conferences,* USFWS/NMFS, 1994).

May affect, likely to adversely affect. The appropriate conclusion when some portion or aspect of the action has a greater than insignificant probability of having a detrimental effect upon individual organisms or habitat. The action is "likely to adversely affect" if it has the potential to hinder attainment of relevant properly functioning indicators, or if there is more than an extremely low probability of taking proposed or listed salmon and resulting in the destruction or adverse modification of their habitat (*The Habitat Approach,* NOAA Fisheries, Northwest Region, 1999). Unfortunately, there is no definition of adverse effects in the ESA or its implementing regulations. According to the Endangered Species Handbook, adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions (USFWS/NMFS 1994). In the event the overall effect of the proposed action is beneficial to the listed species or critical habitat, but may also cause some adverse effects to individuals of the listed species or segments of the critical habitat, then the proposed action 'is likely to adversely affect' the listed species or critical habitat.

Adverse effects include short or long-term, direct or indirect management-related, impacts of an individual or cumulative nature such as mortality, reduced growth or other adverse physiological changes, harassment of fish, physical disturbance of redds, reduced reproductive success, delayed or premature migration, or other adverse effects or behavioral changes to listed anadromous salmonids at any life stage. Adverse effects to designated critical habitat include effects to any of the essential features of critical habitat that would diminish the value of the habitat for the survival and recovery of listed anadromous salmonids (NMFS Pacfish Biological Opinion, 1/23/95). This definition is applied on the individual level as well as on the sub-population and population levels.

A "likely to adversely affect" determination does not require that the action causes take of the listed species. However, when the action does cause take, the determination is always "likely to adversely affect". Take can be authorized in the Incidental Take Statement of a Biological Opinion after the anticipated extent and amount of take has been described, and the effects of the take are analyzed with respect to jeopardizing the species or adversely modifying critical habitat. Take, as defined in the ESA, clearly applies to the individual level, thus actions that have more than an extremely low probability to cause take of individual eggs and/or fish are "likely to adversely affect."

b) Dichotomous Keys and Effects Decision-Making Narratives

Three separate dichotomous keys are presented below. Each key is designed for certain types of projects or programs. NOAA staff should used choose a project or program scenario that best fits their project or program, and then use the dichotomous key for that scenario. The dichotomous key will assist NOAA staff in arriving at the appropriate effects determination and will help determine the need for either informal or formal consultation. A narrative follows each key and includes a description for each step in the keys.

Scenario 1 All stormwater is infiltrated to provide flow control of stormwater runoff quantity.

Scenario 2 Flows from the project site ultimately or directly discharge into an adjacent large water body providing habitat for ESA-listed fish species.

Scenario 3 Surface or groundwater flows discharge directly or eventually into a wetland, stream, or river providing prey or habitat for ESA-listed fish.

To streamline consultation, NOAA staff should encourage project or program applicants/proponents to include conservation measures (or terms and conditions) to avoid or minimize stormwater effects up front and therefore minimize the need for formal consultation.

For Determining Project/Program Effects Related to Stormwater

Dichotomous Key

<u>Scenario 1</u>

Scenario 1 should be used when all stormwater generated by the project or program is infiltrated to provide flow control of stormwater runoff quantity.

Step 1.	Is the infiltration facility sized and designed appropriately, and is water quality pretreatment included?		
		Yes	Proceed to Step 2.
		No	Formal Consultation may be required [1]
Step 2.	Will full infiltration cause hillside or streambank stability problems?		
		Yes	Formal Consultation may be required.
		No	Proceed to Step 3.
Step 3.	Are soils in the infiltration facility suitable for water quality treatment of runoff and avoiding groundwater/receiving water contamination?		
		Yes	Proceed to Step 5
		No	Proceed to Step 4
Step 4.	Is water quality treatment provided prior to the infiltration flow control facility that adequately treats pollutants from on-site pollution generating surfaces (e.g.,		

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[1]Each of the questions that lead to this end-point in the key describes an important project element or an important subwatershed indicator. When important project elements are not included, formal consultation *may* be required. The word *may* is used because it is also possible that an alternative is part of the project design that was not expressly included in these keys. Since it would not be possible to include the whole range of project designs that will occur in the Northwest Region, when this is the case, project biologists should consult with their team leaders and make a judgement on the appropriate effects determination.

When an important subwatershed indicator leads to this end-point, formal consultation *may* be required. These indicators partially describe the overall baseline health of the subwatershed. Subwatersheds with low forest cover and/or high levels of imperviousness; and/or poor riparian coverage; and/or inadequate baseflows where listed species are present, are likely not providing habitat functions necessary for the recovery of the listed species. When a project contributes to the increased degradation of any key indicators (Scenario 3, Steps 9-12), where the existing baseline conditions within the subwatershed approach or exceed these levels, formal consultation would likely be required.

oil) and prevents contamination of groundwater and receiving waterbodies (e.g., phosphorous)?

Yes	Proceed to Step 5
No	Formal Consultation may be required

Step 5. Will the water quality treatment facility capture and effectively treat the volume of runoff predicted from the 6-month, 24-hr storm (i.e., 90-95% of the annual runoff volume) and is there a monitoring and maintenance plan provided?

Yes	NLAA
No	Formal Consultation may be required

Narrative for Scenario 1

All stormwater is infiltrated to provide flow control of stormwater runoff quantity.

Step 1. Is the infiltration facility located in appropriate soils and designed appropriately, and is water quality pretreatment included (as described below)?

Some project locations have appropriate soils (e.g., coarser soils, such as gravelly sands) that could provide flow control for all runoff from new impervious surfaces via infiltration on site. A flow control infiltration facility should be designed to mimic the natural hydrologic balance between surface and ground water as needed to protect habitat and listed species. Continuous flow modeling equivalent to that described in the 1998 King County Washington Surface Water Design Manual (King County Runoff Time Series Level 2 flow control), or in the 2001 Washington State Department of Ecology Stormwater Manual for Western Washington (2001 Washington Stormwater Manual) could be used to determine whether the soils will be able to handle all of the runoff from the altered surfaces.

The basis for determining if all the runoff can be infiltrated is either:

i). Use a continuous runoff model with a stage/storage/discharge table which simulates infiltration rates and the total volume of runoff stacking up within an infiltration basin while it waits to be infiltrated. The basin could be designed to infiltrate all of the predicted runoff, or to infiltrate enough runoff such that the runoff that overflows from the basin into a nearby waterway does not exceed the flow duration curve for the pre-project runoff: or,

ii). If a continuous runoff model is not available for use, then default to a design equivalent to that described in the 1992 Washington State Department of Ecology Stormwater Manual (1992 Washington Stormwater Manual) and single event runoff analysis. The 1992 Washington Stormwater Manual design basis for flow control begins on page III-3-26. It includes the requirement to completely infiltrate all of the runoff from a 10-year, 24-hour storm within one day, and to infiltrate the runoff from a 100-year, 24-hour storm within 2 days: and,

iii). To ensure that the infiltration facility is sized appropriately, the project or program description should take into consideration the total runoff area contributing to the infiltration facility, not just 100% of the new impervious or equivalent area.

Pretreatment of runoff is recommended to remove sediments, particulate, solids, grit, grease, oil, and scum from the runoff prior to entering the infiltration flow control facility. Pretreatment is important to prevent clogging of the facility, and ensure the facility continues to function as designed with minimal maintenance.

Step 2. Will full infiltration cause hillside or streambank stability problems?

The project, or program description should identify these potential problem areas. While it is unlikely an applicant would propose a design that would present an unacceptable risk of slope failure, past consultations have shown this potential still needs to be evaluated. In the event stability problems are identified, then alternate solutions should be explored. Formal consultation under §7 of the ESA may be necessary if risks to ESA listed species and habitat have adverse effects.

Step 3. Are soils in the infiltration facility also suitable for water quality treatment of runoff and avoiding groundwater/receiving water contamination?

Soils that are suitable for flow control are not always suitable for water quality treatment. Infiltration for water quality control uses filtration, adsorption, and biological decomposition properties of the soil to remove pollutants. Soils that are suitable for runoff treatment must have sufficient organic content and sorption capacity to remove pollutants (e.g., silty and sandy loams) so that groundwater/receiving water contamination is avoided. Pollutants of concern include sand, silt, suspended solids, metals (copper, lead and zinc), nutrients (nitrogen, phosphorus), certain bacteria and viruses, and organics (petroleum hydrocarbons and pesticides). The project, or program description, should include information on the soils and the expected contaminants coming off of the newly altered site.

Step 4. Is water quality treatment provided prior to the infiltration flow control facility that adequately treats pollutants from on-site pollution generating surfaces (e.g., oil) and prevents contamination of groundwater and receiving waterbodies (e.g., phosphorous)?

For flow control infiltration facilities using coarser soils, water quality treatment is needed prior to the infiltration facility to protect water quality of receiving waterbodies and groundwater. Typically, removal of suspended solids, oil, and soluble pollutants should occur prior to infiltration. If on-site uses generate high concentrations of oil, an oil control facility should be included. Phosphorus control may be needed if receiving waterbodies are sensitive to phosphorus inputs. If the project site includes high density uses (e.g., industrial, commercial, multi-family and/or arterials and highways), enhanced water quality treatment (e.g., sand filter, treatment wetland, treatment train) may be needed to adequately protect listed species and habitats in downstream lakes and streams, and avoid groundwater contamination. The project, or program description should provide information on the expected pollutants entering the infiltration facility, and how these pollutants will be dealt with prior to infiltration. Treatment methods equivalent to those required in the 2001 Washington Stormwater Manual would be acceptable.

If there are no plans to remove potential contaminants the action agency should determine and explain the risk to groundwater contamination and the fate of this contamination to receiving surface water where ESA species may be present.

Step 5. Will the water quality treatment facility capture and effectively treat the volume of runoff predicted from the 6-month, 24-hr storm (i.e., 90-95% of the annual runoff volume) and is there a monitoring and maintenance plan provided?

Water quality treatment facilities should be sized to treat the volume of runoff predicted from a 24-hour storm with a 6-month return frequency (a.k.a., 6-month, 24-hr storm). This will mean the treatment facility will effectively treat 90-95% of the annual runoff. During most rainfall events during the year, 100% of the runoff will be treated. However, during large storm events not all of the runoff will be treated. Therefore, when combined with all other rainfall events, on average, 90-95% treatment is achieved. Calculations to meet this standard should consider all surface area that will contribute runoff to the water quality treatment facility, not just runoff from newly created impervious surface area. If a continuous runoff model is not available for use, then default to a design equivalent to that described in the 1992 Washington State Department of Ecology Stormwater Manual (1992 Washington Stormwater Manual) and single event runoff analysis. The project or program description should include information on the expected contaminants entering the treatment facility and a description of the treatment facility used to remove these pollutants. In addition, the project or program description should detail the monitoring and maintenance plan to ensure the treatment facility operates as designed in perpetuity. Standards equivalent to those required in the 2001 Washington Stormwater Manual would be acceptable.

For Determining Project/Program Effects Related to Stormwater

Dichotomous Key

Scenario 2

Scenario 2 should be used when flows from the project site ultimately or directly discharge into an adjacent large water body providing habitat for ESA-listed species such as Puget Sound, Columbia River, or into a large lake.

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Step 1.	Will site runoff be routed to a sewage treatment facility?		
		Yes	Proceed to Step 2.
		No	Proceed to Step 3.
Step 2.	Could sewage and/or combined sewage and stormwater overflows adversely affect ecological functions that support listed species?		
		Yes	Formal Consultation may be required.
		No	NLAA.
Step 3.	No flow controls are needed. Do flows from the project site discharge through a made-made or man-altered conveyance system into an adjacent large water body, and are erodible elements of these conveyance systems adequately stabilized to prevent erosion?		
		Yes	Proceed to Step 4.
		No	Formal Consultation may be required.
Step 4.	Will the water quality treatment facility capture and effectively treat the volume of runoff predicted from the 6-month, 24-hr storm (i.e., 90-95% of the annual runoff volume) and is there a monitoring and maintenance plan provided?		
		Yes	NLAA
		No	Formal Consultation may be required.

Narrative for Scenario 2

Flows from the project site ultimately or directly discharge into an adjacent large water body providing habitat for ESA-listed fish species such as Puget Sound, Columbia River, or into a large lake.

This project description was identified as a separate scenario because some projects that discharge stormwater either ultimately (e.g., via a sewage treatment plant and then to a large water body) or directly into adjacent large water bodies may not need to provide flow controls. The objective of flow controls is to prevent increases in stream channel erosion rates that are characteristic of natural conditions. As a result, discharge from project sites located adjacent to salt water bodies would not need flow controls. In addition, discharge from project sites located adjacent to large lakes (e.g., Lakes Sammamish, Silver, Union, Washington, and Whatcom) and discharging directly into these lakes would not need flow control. These lakes have a large volume and an outlet configuration that minimizes elevation of lake levels and subsequent erosion in downstream channels. As well, flow control for discharge from project sites into large rivers such as the Columbia and Lower Willamette are not needed. It is possible that project site discharges into other large water bodies may not need flow controls, but a justification by the project applicant would be considered on a case-by case basis.

Step 1. Will site runoff be routed to a sewage treatment facility?

The project, or program description should describe the fate of the runoff from the site(s), and the type of treatment facility, including routing to a sewage treatment facility.

Step 2. Could sewage and/or combined sewage and stormwater overflows adversely affect ecological functions that support listed species?

Insufficiently treated effluent (sewage receiving primary treatment or combined sewer overflows (CSO's)) discharged into surface waters or the nearshore environment is likely to adversely affect ESA listed fish. Contaminants from outfalls that enter the substrate or the surface layer, may find their way into the food web, subsequently be ingested by juvenile salmon, and may result in a reduction in the probability of survival (NOAA Fisheries Biological Opinion WSB-00-039, June 19, 2000). Accumulation of contaminants in the sediments can cause adverse impacts to juvenile salmon growth rates and result in reduced survival. Adverse effects to listed fish have been documented where there is a CSO discharge to freshwater (McCain et al. 1990).

The reviewer may want to ask if offsetting flow reduction measures have been taken so that the volume and frequency of the downstream overflows and sewage treatment plant discharge do not increase. In Washington State, for example, cities are not allowed to increase the stormwater runoff from their areas served by combined sewers without first taking measures to prevent the increase in annual CSO volumes and frequencies.

Step 3. No flow controls are needed. Do flows from the project site discharge through a made-made or man-altered conveyance system into an adjacent large water body, and are erodible elements of these conveyance systems adequately stabilized to prevent erosion?

If discharge of runoff into man-altered conveyance systems (e.g., non-fish bearing stabilized swales or drainages) can be achieved without erosion, then this should be encouraged. However, when this cannot be achieved without subsequent erosion and sedimentation, manmade conveyance systems (e.g., piped systems) should be developed to eliminate any potential erosion between the water quality treatment facility and the large water body. Water quality treatment should be as described in Step 4 below.

Information on the area to be impacted by creating a man-made conveyance system is important. Additional measures should be considered to minimize potential habitat impacts associated with the creation of a conveyance system.

Step 4. Will the water quality treatment facility capture and effectively treat the volume of runoff predicted from the 6-month, 24-hr storm (i.e., 90-95% of the annual runoff volume) and is there a monitoring and maintenance plan provided?

Water quality treatment facilities should be sized to treat the volume of runoff predicted from a 24-hour storm with a 6-month return frequency (a.k.a., 6-month, 24-hr storm). This will mean the treatment facility will effectively treat 90-95% of the annual runoff. During most rainfall events during the year, 100% of the runoff will be treated. However, during large storm events not all of the runoff will be treated. Therefore, when combined with all other rainfall events, on average, 90-95% treatment is achieved. Calculations to meet this standard should consider all surface area that will contribute runoff to the water quality treatment facility, not just runoff from newly created impervious surface area. If a continuous runoff model is not available for use, then default to a design equivalent to that described in the 1992 Washington State Department of Ecology Stormwater Manual (1992 Washington Stormwater Manual) and single event runoff analysis. The project, or program description should describe the expected contaminants coming off of the newly altered site and the treatment facilities used to remove these pollutants. In addition, the project or program should detail the monitoring and maintenance plan to ensure the treatment facility operates as designed in perpetuity. Standards equivalent to those required in the 2001 Washington Stormwater Manual would be acceptable.

For Determining Project/Program Effects Related to Stormwater

Dichotomous Key

<u>Scenario 3</u>

Scenario 3 should be used when surface or groundwater flows from a project or program area discharge directly or eventually into a wetland, stream, or river providing prey or habitat for ESA-listed fish species.

Step 1.	Will site runoff be routed to a sewage treatment facility?		
		Yes	Proceed to Step 2.
		No	Proceed to Step 4.
Step 2.	Could sewage and/or combined sewage and stormwater overflows adversely affect ecological functions that support listed species?		
		Yes	Formal Consultation may be required.
		No	Proceed to Step 3.
Step 3.	Is the project, or program, contributing to decreased base flows in a subwatershed with evidence of low or inadequate base flow conditions?		
		Yes	Formal Consultation may be required.
		No	NLAA
Step 4.	Will the water quality treatment facility capture and effectively treat the volume of runoff predicted from the 6-month, 24-hr storm (i.e., 90-95% of the annual runoff volume) and is there a monitoring and maintenance plan provided?		
		Yes	Proceed to Step 5.
		No	Formal Consultation may be required.
Step 5.	Is the project contributing to decreased forest cover (FC) in a subwatershed at or below 65% FC? Or, increased total impervious area (TIA) in a subwatershed approaching or exceeding, 10% TIA?		
		Yes	Proceed to Step 8.
		No	Proceed to Step 6.
Step 6.	Is the project decreasing riparian zone function in a where 35% or more of the riparian zone is less than 30 meters wide?		
		Yes	Proceed to Step 9.
		No	Proceed to Step 7.

Step 7. Is the project contributing to increased flow durations at flows less than 50% of the 2-yr discharge in a subwatershed or reach where there is evidence of stream bank or channel erosion / down-cutting ($Q_{2\text{-current}} \geq Q_{10\text{-forested}}$)?

Yes	Proceed to Step 10.
No	Proceed to Step 11.

Step 8. Will forest cover (FC) be provided equal in function or greater than FC removed? Or, will impervious surface (IS) be removed equal in function or greater than IS added?

Yes	Proceed to Step 6.
No	Formal Consultation may be required.

Step 9. Is riparian vegetation replaced greater than or equal in function to that being removed?

Yes	Proceed to Step 7.
No	Formal Consultation may be required.

Step 10. Is stream side or riparian vegetation replaced and/or, is large wood (LW) installed (where appropriate) to adequately minimize flow duration effects at flows less than channel forming flows?

Yes	Proceed to Step 11.
No	Formal Consultation may be required.

Step 11. Is the project contributing to decreased base flow in a subwatershed with evidence of low or inadequate base flow conditions?

Yes	Formal Consultation may be required.
No	Proceed to Step 12.

Step 12. Is surface runoff being treated to match water quality conditions described in Step 4 above, and managed to match developed discharge durations to pre-developed durations for the range of predeveloped discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow? Also, is a monitoring and maintenance plan provided to ensure facilities are operating as designed, and will continue to operate as originally intended?

If stream:	Yes	NLAA
If wetland:	Yes	Proceed to Step 13.

	No	Formal Consultation may be required.

Step 13. Will discharge to wetlands maintain hydrologic conditions, hydrophytic vegetation and substrate characteristics necessary to support existing wetland conditions?

	Yes	NLAA
	No	Formal Consultation may be required.

<u>Narrative for Scenario 3</u>

Surface or groundwater flows discharge directly or eventually into a wetland, stream, or river providing prey or habitat for ESA-listed fish species.

Step 1. Will site runoff be routed to a sewage treatment facility?

See explanation under Scenario 2, Step 1.

Step 2. Could sewage and/or combined sewage and stormwater overflows adversely affect ecological functions that support listed species?

See explanation under Scenario 2, Step 2.

Step 3. Is the project, or program contributing to decreased base flows in subwatershed with evidence of low or inadequate base flow conditions?

As depicted in Figure 1, infiltration decreases dramatically with increases in impervious surface within a subwatershed. Decreases in infiltration can lead to decreases in seasonal low-flow (base flow) conditions. These decreases can be detrimental to fish. Higher temperatures could result with lower base flows when the low-flow events coincide with summer weather conditions. Increased temperature reduces available oxygen in the water and can lead to disease problems. Low flow conditions also can cause physical blockages to upstream and downstream migration, reducing available habitat, and leading to increased competition between species. Best Management Practices for stormwater control have yet to adequately address potential low flow issues resulting from increased runoff during the rainy season in the Pacific Northwest. The biological assessment should contain information on base flow levels in the subwatershed. For some subwatersheds, this information is available from local jurisdictions (e.g., Basin Planning documents, watershed councils) or state agencies participating in watershed planning efforts (e.g., the Limiting Factors Analysis conducted by the Washington State Conservation Commission), or the U.S. Geological Survey Applicants should look for methods that will minimize the effect on hydrology (refer to Table 1).

Step 4. Will the water quality treatment facility capture and effectively treat the volume of runoff predicted from the 6-month, 24-hr storm (i.e., 90-95% of the annual runoff volume) and is there a monitoring and maintenance plan provided?

See explanation under Scenario 2, Step 4.

Step 5. Is the project contributing to decreased forest cover (FC) in a subwatershed at or below 65% FC? Or, increased total impervious area (TIA) in a subwatershed approaching or exceeding, 10% TIA?

As depicted in Figure 1, increases in impervious surface in a subwatershed results in decreases in infiltration and evapotranspiration, while surface runoff increases (Arnold and Gibbons 1996, Beyerlein 1999, National Academy of Science 2002). Some of these changes are a result of the loss of forest cover and as a result, forest cover is a consistent indicator of stream health. Data collected from field observations in western Washington have shown that 65% forest cover in a subwatershed was necessary to maintain stable stream channels (Booth, 2000).

There is ample scientific evidence that relates imperviousness and land conversions (e.g., forest-to-pasture conversions), to specific changes in the hydrology, habitat structure, water quality and biodiversity of aquatic systems (Refer to Figure 1 and Appendix A of this document). The compendium of research, conducted in many geographic areas, concentrating on many different variables, and employing widely different methods, has yielded surprisingly similar conclusions, that stream degradation can occur at relatively low levels of imperviousness (Booth and Jackson 1997, Paul and Meyer 2001, National Academy of Sciences 2002, Center for Watershed Protection, 2002). Physical bed and streambank degradation is evident from impervious-induced flow increases, characterized by both peak discharges and the aggregate duration of sediment transporting events. Data published in Booth and Jackson (1999) showed that when effective impervious area (EIA) in a subwatershed exceeded 10%, physical degradation of the stream channels was ubiquitous.

While preserving forest cover and limiting EIA are both critical for preserving stream channels (Center for Watershed Protection, 2002), hydrological analyses suggest that forest cover is more important than impervious area in protecting stream channels. Data show that at 65% forest retention, EIA and TIA is $\leq$10% in all cases, yet with EIA and TIA > 10%, clearing resulting in substantially less than 65% forest cover is commonly observed (Booth 2000, Kitsap County 2000). The project or program description should provide subwatershed scale data on the amount of impervious surfaces (TIA, or EIA, if possible) and forest cover.

Step 6. Is the project decreasing riparian zone function in a subwatershed where 35% or more of the riparian zone is less than 30 meters wide?

The riparian community directly influences the physical, chemical, and biological conditions of the aquatic ecosystem. Physical attributes, including dense, complex and diverse understory and groundcover vegetation; and extensive upper soil-layer of forest "duff" provides vital water retention and filtering capacity (National Academy of Science 2002). These attributes associated with mature riparian forests help to minimize the water quantity and water quality impacts of stormwater runoff and non-point pollution on aquatic ecosystems. Therefore, the condition of the riparian zone can be a significant mitigating element against increasing impervious surface cover or loss of forest cover elsewhere in the subwatershed. The riparian zone should be at least 65% intact with a minimum 30-meter width (May et al. 1997). On the west side of Oregon and Washington, the vegetation should generally include conifers as the dominant cover or the complex of endemic species that existed historically for that system. In general, the relatively young, deciduous riparian forests that are common in lowland subwatersheds do not provide all of the functions that mature riparian forests do (May et al. 1997). Information about the condition of the riparian zone within the subwatershed should be included in the project or program description.

Step 7. Is the project contributing to increased flow durations at flows less than 50% of the 2-yr discharge in a subwatershed or reach where there is evidence of stream bank or channel erosion / down-cutting ($Q_{2\text{-current}} \geq Q_{10\text{-forested}}$)?

It has been well documented that stream channels can change with increased stormwater runoff from land conversions, resulting in an increased magnitude, frequency and duration of flows. This leads to increased channel erosion as channel incision and widening occur to accommodate increased bankfull discharge (May et al. 1997, Paul and Meyer 2001, National Academy of Sciences 2002). There has been a presumption made that there will be no effects from increased flow durations when engineered duration controls are applied to a project (i.e., the duration of flows above 50% of the 2-yr will be the same as pre-development). However, this method requires that durations below 50% of the 2-yr will increase dramatically, even though there has been no evaluation of either the physical or biological effects of extended flow durations (Booth et al., 2002) on listed salmonids. Of particular concern are possible effects to juvenile salmonids and their prey species, especially in stream systems where channel instability resulting from increased runoff, has already been observed.

The project or program description should provide information on the condition of the receiving stream channel and stream banks within the reach or subwatershed. This can include a qualitative description (e.g., condition of erosion in stream channel and/or banks) or a quantitative description (e.g., $Q_{2\text{-current}}$ compared to $Q_{10\text{-forested}}$). Booth and Jackson found (1997) that the transition from stable to unstable stream channels occurred when the 10-year forested (i.e., pre-development) discharge ($Q_{10\text{-forested}}$) equaled the 2-year current discharge ($Q_{2\text{-current}}$). Channel conditions should be described both above and below the project location. If the stream is not fish-bearing, but drains to a system that does contain listed species, the survey of the channel and bank conditions should extend partially into this system as well.

Step 8. Will forest cover (FC) be provided equal in function or greater than FC removed? Or, will impervious surface (IS) be removed equal in function or greater than IS added?

As a way of minimizing effects from a project (e.g., removal of trees, compaction or removal of native soils, increased imperviousness), forest cover equivalent in function to that being removed can be provided. And/or impervious surfaces equal to or greater than that added can be removed, and vegetation can be planted. Areal extent of vegetation planting should take into consideration temporal losses in function to sufficiently minimize effects. In addition, to maximize the effectiveness of reclaimed areas, soils can be upgraded by using on-site native topsoil, incorporating amendments into on-site soil, or incorporating blended topsoil (soil reclamation equivalent to the post-construction soil quality and depth requirements in the 2001 Washington

Stormwater Manual would be acceptable), planted with native evergreen trees and shrubs, and protected in perpetuity by a legal document (e.g., a conservation easement, park, deed restriction, etc.).

Step 9. Is riparian vegetation replaced greater than or equal in function to that being removed?

As stated above, the riparian vegetative community directly influences several aquatic ecosystem functions. Some of the project's impacts may be sufficiently minimized if riparian vegetation within the subwatershed is replaced in function greater than or equal to that which is removed by the project. Areal extent of riparian vegetation planting should take into consideration temporal losses in function to sufficiently minimize effects.

Step 10. Is stream side or riparian vegetation replaced and/or, is large wood (LW) installed (where appropriate) to adequately minimize flow duration effects at flows less than channel forming flows?

Applying engineered duration flow controls to the project will maintain flow durations at pre-development levels for flows above 50% of the 2-yr up to the 50-yr flow, but durations of flow below 50% of the 2-yr flow will increase. As Booth et al. (2002) note, there has been no evaluation of other physical and biological effects of extended low flow durations. These extended durations could cause adverse effects particularly to rearing juveniles in streams with limited high flow refuge areas and to benthic organisms that are prey sources for listed species. In some cases, where the existing baseline condition of the stream channel or bank is degraded, placement of large wood can be part of a project proposal to restore some hydrologic function. This restoration option along with improving stream-side vegetation may adequately minimize stormwater effects of the proposed project.

Step 11. Is the project, or program, contributing to decreased base flow in a subwatershed with evidence of low or inadequate base flow conditions?

See explanation under Scenario 3, Step 3.

Step 12. Is surface runoff being treated to match water quality conditions described in Step 4 above, and managed to match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow? Also, is a monitoring and maintenance plan provided to ensure facility/ties is/are operating as designed, and will continue to operate as originally intended?

Flows being discharged according to this criteria should not cause additional erosion of the stream channel and streambank downstream of the discharge point. Because land conversions typically increase the volume of stormwater runoff, the increased discharges can destabilize channels, as sediment is transported from the channel and banks. The channel and banks would be protected if the increased volumes are released at rates too small to transport sediment. Based on available studies, Booth (1993) demonstrated that the lower threshold of significant bedload-sediment movement that would protect most channels is 50% of the 2-year discharge. A continuous rainfall/runoff model should be used if one is available. If not, standards equivalent to those required in the 2001 Washington Stormwater Manual would be acceptable. The pre-developed condition to be matched should be a forested land cover unless reasonable, historic information is provided that indicates the site was prairie prior to settlement.

Step 13. Will discharge to wetlands maintain hydrologic conditions, hydrophytic vegetation and substrate characteristics necessary to support existing wetland conditions?

As wetlands provide important ecological functions for listed species, it is important to ensure wetlands receive adequate levels of protection. With respect to stormwater effects, these protections should go beyond those connected wetlands which provide direct habitat for ESA-listed fish (e.g., freshwater, marine and estuarine wetlands that provide habitat for rearing and migration). Wetlands are important natural resources which provide multiple stormwater benefits, including groundwater recharge (potentially augmenting stream baseflows), stormwater and flood control, food chain support, water purification, and shoreline and stream channel erosion protection. Wetlands are potentially vulnerable to stormwater discharges due to pollutants in the runoff and disruption of natural hydrologic functioning of the wetland system (Horner et al., 1996). Changes in water levels and the frequency and duration of inundations can adversely affect aquatic and bank or shoreline vegetation. Careful modeling and specific expertise is needed to accurately support an affirmative answer to this question.

c) Examples of Effect Determinations

NOAA Fisheries recommends that when feasible, evaluators conference/consult at the reach, subwatershed or watershed scale rather than on individual projects.

<u>No effect</u>

Due to the strict definition above of "no effect," the interrelated nature of in-stream conditions and subwatershed conditions, and the scale of these conferences/consultations and activities, "no effect" determinations for all actions in a subwatershed could be rare when proposed/listed species are present in or downstream from a given subwatershed. However an evaluator may identify some plausible exceptions to this general rule.

Example 1 (no effect):

The proposed project is outside the riparian zone, will take place where there are stable permeable soils (no slide hazards), will remove six trees, add 3,000 square feet of impervious surfaces, and remove 3,000 square feet of impervious surface. All stormwater runoff from this site will be infiltrated. Other indicators in the subwatershed, as described in the draft matrix in Appendix B (e.g., low total percentage of imperviousness, highly functional riparian habitat and instream conditions), are highly functional and will not be impacted by the project. The project also calls for restoring native vegetation on a portion of the action area.

Rationale for No Effect Determination (example 1):
The presence of permeable soils, stable slopes, removal of impervious surface equal to that being added, plus infiltration of all runoff will result in no impact to base flows and water quality. The impervious surface added is not "effective impervious surface," meaning runoff will not contribute to a hydrologic response by any receiving waters. While some trees will be removed, the soils will able to handle the increase in precipitation that hits the ground, and the restoration of native vegetation will offset this impact. The subwatershed has very low level of imperviousness. It is not stated how much of the baseline imperviousness is "effective impervious" verses "total impervious", but the riparian corridor is in very good condition. This action would show no effect on stream hydrology.

Example 2 (no effect):
The proposed project is within a subwatershed where no listed species occur and where no critical habitat is proposed or has been designated. The proposed action will add 10,000 square feet of impervious surface. All stormwater runoff from the site will infiltrate into the surrounding vegetation/soils.

Rationale for No Effect Determination (example 2):
No listed species are present in the subwatershed. All runoff will be infiltrated into the surrounding soils, so no effects are expected to water quality or hydrology in water bodies with listed salmonids..

<u>May affect, not likely to adversely affect</u>

Example 1 (NLAA):
The proposed project is in an area with stable soils, and outside the riparian zone. The project will add 24,000 square feet of impervious surfaces to the subwatershed where the total percentage of impervious surface is less than 5%. Half of the stormwater runoff from the constructed site will be infiltrated. Infiltration of additional rainwater will not destabilize any slopes. The other half of the runoff will be treated using standards equivalent to the 2001 Washington Stormwater Manual requirements for flow control and for water quality treatment. The average annual flow of the receiving stream is 50 cubic feet per second. The predicted increase in stream flow from the two-year 24-hour event will be 0.025%. Habitat studies on this system show that juvenile salmon refugia habitat is good and aquatic benthic invertebrates are extremely diverse (greater than 30 species) and abundant. The riparian zone is fairly continuous and ecologically mature.

Rationale for NLAA Determination (example 1):

At a subwatershed scale, an increase of 24,000 square feet of impervious surfaces is not very much. It is roughly equivalent to 5 single-family houses. The subwatershed is not heavily developed. While it does not say whether the impervious surface in the subwatershed is "total" or "effective" it is still low. The applicant may know whether the impervious surface value is total or effective, so it would be a good question to ask. There are also formulas that local governments use to predict effective impervious surface from total impervious surface. Fifty percent of the runoff will not leave the site but will be infiltrated. This will help keep base flows from being impacted. Because the basin is relatively undeveloped, it is likely base flows are not currently degraded. But this is not always a safe assumption. There may be other factors besides development that may affect baseflow conditions such as water withdrawals for single family homes. When applicants say that all or a portion of the runoff will be infiltrated, you need to know how this was calculated. The basis for determining that all the runoff is infiltrated is either:

i). Use an approved continuous runoff model with a stage/storage/discharge table which simulates infiltration rates and the total volume of runoff accumulated within an infiltration basin while it waits to be infiltrated. The basin could be designed to infiltrate all of the predicted runoff, or to infiltrate enough runoff such that the runoff that overflows from the basin into a nearby waterway does not exceed the flow duration curve for the pre-project runoff; or,

ii). If a continuous runoff model is not available for use, then default to an approach similar to the 1992 Washington Stormwater Manual and single event runoff analysis. It includes the requirement to completely infiltrate all of the runoff from a 10-year, 24-hour storm within one day, and to infiltrate the runoff from a 100-year, 24-hour storm within 2 days.

iii). Make sure it is clear that infiltration should be for the total runoff area, not just 100% of the new impervious or equivalent area.

You also need to determine if the infiltrated runoff will cause slope instability. Treatment equivalent to the 2001 Washington Stormwater Manual will be applied to the other 50% of the rainwater. That is, stormwater discharges shall match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. Unless reasonable evidence of historic conditions suggests otherwise, the predeveloped condition to be matched shall be a forested land cover. The condition of the stream biota is excellent as is the stream morphology and riparian zone. It is highly unlikely this project will have an adverse effect on listed species.

Example 2 (NLAA):
The proposed project will remove 5 acres of second growth to build a small sub-division outside of the riparian zone. Almost all native vegetation and soils will be removed or

altered. Except for the access road to the new lots, no additional road will be built nor existing roads widened. Stormwater from the project site will be treated for quality and quantity following standards equivalent to the 2001 Washington Stormwater Manual standards. Developers have proposed a 15-year monitoring plan to insure the stormwater facilities over time continue to function as designed. The area drains into a small intermittent stream that feeds West Prior Creek 3 miles away. Monitoring shows that the small intermittent stream does not support anadromous fish. West Prior Creek has an average annual flow of 110 cubic feet per second and supports threatened coho salmon. The additional 96,000 square feet of impervious surface from the completed project will raise the total impervious surface within the subwatershed (which includes West Prior Creek) to 7 percent. Runs of listed coho salmon in West Prior Creek are considered to be relatively strong. Water quality parameters are considered good, and refugia habitat is sufficient in size, number and connectivity to maintain a viable epibenthic prey community and coho rearing. The riparian community is well established along most of West Prior Creek, and there is ample large wood throughout most of the system. There is good substrate in the creek consisting of mostly gravel with some cobble and larger material. Base flows and summer temperatures have never been documented to be a problem in West Prior Creek

Rationale for NLAA Determination (example 2):
Five acres of native vegetation (second growth conifers) will be removed. This means that in these 5 acres, an additional 17 inches of runoff will be generated per year and approximately 7 inches of groundwater recharge potential will be lost per year (Beyerlein 1999). While the 2001 Washington Stormwater Manual standards will be followed to treat for water quality and quantity, the increase in flow volumes could be detrimental to stream biota. The standards should protect against stream channel and stream bed erosion. The level of imperviousness within the subwatershed is rising to levels where significant impacts are reported in the literature. However, the flow is discharged into a stream that reportedly does not support listed species. The flow does eventually enter into a coho-producing creek where the runs are considered strong. The riparian community is well established and the development will not affect it. Riparian conditions are linked with a healthy benthic community structure and abundance. Refugia habitat is in excellent condition, the increased volumes of flow should not alter this condition. The spawning substrate is good (past development has not affected stream scour to bedrock conditions). Flow controls according to the 2001 Washington Stormwater Manual standards should protect the substrate conditions. The 15-year monitoring to ensure proper function of the stormwater facilities will provide adequate information on the functioning of this facility. In addition to making sure the facilities continue to operate as designed, monitoring should address some downstream effects such as: substrate embeddedness, channel erosion, benthic community, and refugia habitat.

<u>May affect, likely to adversely affect</u>

Example 1 (LAA):

The proposed project is in an area with stable soils, and outside the riparian zone. This project will add 75,000 square feet of impervious surface to the subwatershed where the total percentage of impervious surface is presently over 20%. The riparian zone is degraded by past land-use practices. Post-construction stormwater runoff from the site will be controlled using standards equivalent to 2001 Washington Stormwater Manual flow and water quality control requirements. Available monitoring in this basin shows that low base flows and degraded riparian conditions are responsible for elevated temperatures and low dissolved oxygen. The river channel itself is degrading (becoming incised) with little refugia habitat for salmonids and no significant large wood present. The river still supports listed chinook salmon, although their numbers have been steadily declining over the past ten years, while the percent of impervious area in the subwatershed has been on a continuous rise for 18 years.

Rationale for LAA Determination (example 1):
On a subwatershed scale, 75,000 square feet may appear insignificant (over 1½ acres), however the subwatershed is getting built out as indicated by the 20% impervious surface area. In addition, the riparian zone, which would mitigate for some of the impervious surface, is degraded, and consequently cannot offset some of the effects of the runoff. The river channel is degraded and little refugia habitat remains for salmonids. While the standards equivalent to the 2001 Washington Stormwater Manual applied to this development will prevent increased erosive flows off this site, the base flows have already been significantly impacted. Implementation of these standards does not prevent a further degradation of an already reduced base flow. Even with the implementation of equivalent 2001 Washington Stormwater Manual standards, development will add increased stormwater volumes (below 50% of the two-year) to the river and for an extended duration. The increase in flow volumes and durations may likely have an adverse effect on juvenile fish and their prey. Additional runoff from this site during the rainy season, means less runoff is being infiltrated, which may further degrade seasonal base flow conditions, stream temperatures, and dissolved oxygen.

Example 2 (LAA):
The proposed project is a road widening project running parallel to and in the riparian zone of the Coweeman River. The project will add 130,000 square feet of impervious surface. Several large trees will be removed as a result. The trees will be placed where appropriate in the river as large wood to create some habitat for salmonids. Stormwater runoff will be treated following standards equivalent to the 2001 Washington Stormwater Manual. The Coweeman river is showing signs of stress. Most indicators are "at risk" or "not properly functioning."

Rationale for LAA Determination (example 2):
Increased impervious surface is proposed in the riparian zone. Mitigating attributes from riparian vegetation, known to offset some impacts from impervious surfaces and stormwater runoff, will be lost. The loss of riparian vegetation will negate the possibility

that the large wood placed in the river will be sustained through natural processes. Other indicators show that the system is already significantly stressed.

III. Conservation Measures

a) Recommended Measures to Avoid and Minimize Effects

During section 7 consultations, and review of 4(d) or HCP programs, it is the goal of NOAA Fisheries to approach the natural hydrology of the watershed in terms of evapotranspiration, surface runoff, infiltration, timing, duration and magnitude of stream flows, and base flows. Water quality and water quantity should be adequate to support the needs of spawning, rearing and migrating native salmonids. To achieve these goals, a larger-scale subwatershed or watershed landscape approach may be necessary. Modification of transportation planning and development, and local land use practices, is fundamental to controlling the effects of stormwater on natural stream systems. NOAA Fisheries encourages local and state governments to modify regulations or ordinances to encourage low impact development that will result in stormwater quality and quantity within their jurisdictions that supports ESA-listed fish. Changes in local regulations may include measures such as tax incentives to keep land in natural vegetation, maintenance of forest cover, increased use of alternative transportation modes, increased density, incentives to encourage low impact development, and the purchase of water and timber rights. Individual project review should tier back to and support the hydrologic and water quality goals of the subwatershed.

In support of this concept, measures or best management practices (BMPs) that use natural watershed features and processes to minimize or avoid effects of stormwater runoff should be considered and used before an applicant resorts to an engineered method of treatment in new development projects. A combination of watershed features and engineering solutions should be examined for redevelopment projects.

NOAA Fisheries recognizes that different BMP strategies are appropriate for subwatersheds with different levels of development and with differing biological health. In subwatersheds with limited development and productive aquatic ecosystems, BMP's that preserve the land cover (such as land purchase, conservation easements, transfer of development rights, low impact development techniques, etc.) are more beneficial in maintaining habitat conditions that support listed fish than engineered methods (Horner et al. 2002). In subwatersheds with higher levels of development and already degraded biological conditions (where forests, wetlands, and riparian zones have already been removed), further degradation can be avoided and some improvement can be provided using engineered BMP's, and trying to get back some natural riparian zones, upland forests and wetlands.

The goal of each set of BMPs is provided in Table 1, with the individual BMPs prioritized within each set. Because of the wide variety of land uses and geographic areas across the Northwest Region, the list of BMP's is not expected to include all possible BMP's that could be utilized.

In addition, stormwater effects often occur in conjuction with other project effects, and BMP selection would then depend on addressing more than one kind of project effect. When submitting a project or program for NOAA Fisheries review, the rationale and predicted success should be provided for each BMP selected.

Table 1. Best management practices (BMP) to avoid and minimize the effects of stormwater on listed salmonids using natural watershed features (W) and engineered features (E). These BMPs are most applicable in the Pacific Northwest.

Goal of BMP	BMP
Increase infiltration	When soils are appropriate, infiltrate surface water on site. (W/E)
	Remove existing impervious surface so that a net decrease in total impervious area exists in the drainage area. (W) Soil amendments may be needed.
	Upgrade current stormwater management from retention/detention and vault systems to infiltration, disconnecting ditches that convey stormwater to streams, removing existing curbs to promote infiltration of stormwater. (W/E)
	Use pervious pavement/surface where appropriate (sidewalks, bike footpaths, parking lots). (W/E)
	Add 30% compost by volume to topsoil to enhance soil porosity (Marx et al. 1999). (W)
Retain vegetation [2]	Retain native woody vegetation.
	Plant riparian areas with native vegetation (trees) to a width equal to one site potential tree height (spth). (W)
	Decrease grass and plant native trees (conifers) with a goal 65% forest cover (minimum) in the basin. (W)
	Acquire wetlands, riparian areas and upland areas for infiltration reserves to improve hydrologic function and increase vegetated area in drainages and restore connectivity to the floodplain. (W)
Protect or improve water quality and hydrology	Locate water quality/quantity treatment structures outside of riparian, shoreline, and wetland buffer areas.
	For water quantity control the duration of discharge of developed surface runoff should match predeveloped duration for the range of predeveloped discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. Use a water quality treatment facility that treats 90-95% of the annual stormwater runoff volume. (E)
	Use stormwater treatment structures/techniques that are self-maintaining or are very low maintenance (swales, filterstrips etc.) And are shown to be effective. (E)
	Use ultra-urban stormwater systems under paved areas or within existing catch basins or stormwater manholes such as the media filters. (E)
	Retrofit existing untreated impervious surface with detention/treatment so that stormwater discharges shall match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50% of the 2-year peak flow up to the full 50-year flow. Use a water quality treatment facility that treats 90-95% of the annual stormwater runoff volume. (E)
	After a subwatershed or watershed analysis is completed, install LW in streams as appropriate to stabilize and rebuild channels (Roni et al. 2000). (E)
	Do not fill or develop inside the 100-year floodplain.
Protect or Improve Channel Conditions	Move existing residential/business structures outside of the 100-yr floodplain.
	Set bridge support structures outside the bankfull width at minimum, and if possible outside the 100-yr floodplain.
	Set back levies or reduce rip rap banks to provide opportunity for channel movement and/or more appropriate fish habitat.
	Plant vegetation in front of, on top of, and behind levies or dikes to provide shade and leaf litter.
	Do not fill or develop inside the 100-year floodplain.

Protect or Improve Subwatershed/ Watershed Conditions	Restore/rehabilitate historical estuarine/wetland areas.
	Decrease effective impervious surface to below 5% (Paul and Meyer 2001).
	Remove impervious surface from the riparian areas.
	Reduce the number of stream/river crossings.
	Reduce invasive species in riparian areas and maintain native vegetation.
	Remove non-natural structure (tires, old cars, creosote pilings) from water bodies.
Restoring natural hydrology	Make changes to land use regulations (made by local , State, Federal and Tribal land use agencies) to attain any or part of the above listed items.
	Make changes in local regulations that modify land use practices to improve water quality/quantity such as tax incentives, increased use of alternative transportation modes, redevelopment, increased density, etc.
	Purchase/acquire water rights, timber rights.
	Inventory and develop a drainage plan for the basin.
Develop education programs for citizens	Correctly dispose of hazardous household products, and lawn and garden care products.
	Use non-toxic household and garden products whenever possible.
	Recycle and dispose of all trash properly.
	Conserve water.
	Use natural fertilizers in the yard. Minimize pesticide use.
	Avoid over-watering lawns and gardens.
	Maintain septic systems properly.
	Recycle used motor oil.
	Plant trees.
	Decrease impervious surfaces around the home.
	Wash cars on the lawn and turn off water between rinses.

[2] In arid regions of Oregon, California, and Idaho, appropriate native trees should be planted and maintained.

b) Model Terms and Conditions

The following are suggested terms and conditions that can be applied to actions that predict effects to riverine or wetland hydrology and water quality as a result of stormwater runoff. They are applicable throughout the Pacific Northwest, with appropriate modifications and refinements for local conditions (e.g., soil type, precipitation patterns). The goal of the terms and conditions is to approach or preserve natural hydrology and adequate water quality such that take is minimized, making the proposed action or program adequate to support the survival and recovery of listed salmonids. The research presented in Appendix A demonstrates that adequate water quality and hydrology to support salmonids must approach the normative condition in terms of magnitude, frequency and duration of peak and low flows. There is no minimum amount or threshold of impervious surface or loss of forest cover that needs to be proposed prior to imposing the terms and conditions. Typical projects that should incorporate some of the suggested terms and conditions include:

- Single construction projects that take place within the riparian zone, or within a subwatershed with listed salmonids.
- Highway construction projects that result in ground disturbance, including but not limited to projects that add new impervious surface.
- Development and redevelopment projects within urban and urbanizing areas.
- Projects that propose to convert the land from one use to another (e.g., forest to rural, rural to urban) such that there is a change in land cover.

These are generalized terms and conditions, and therefore should not be applied *pro forma*. Caution is needed before applying them to individual projects. Adjustments will be required based on the specific actions proposed and the anticipated effects, as well as local soil, hydrological, and biological conditions. Likewise, new terms and conditions may be needed to appropriately minimize or avoid the potential for take as a result of stormwater, and other terms and conditions may be necessary to minimize the potential for take that result from other effects of the proposed action or program.

Language provided below can be modified as needed. Likely standard language is in **bold font**, further explanation and examples are in regular font, and explanations of the intent of the condition is provided in [square brackets].

<u>Reasonable and Prudent Measures</u>
<u>The (Federal action agency) shall:</u>

1. **Minimize incidental take from development or land conversions by avoiding or minimizing adverse effects to watershed processes, or riparian or aquatic systems through the protection of subwatershed or reach water quality and natural hydrology.** [This requires protection of the pre-development timing, magnitude and duration of instream peak flows and base flows, and may include protection of evapo-transpiration and infiltration rates and protection of natural soils and vegetation.]

2. **Complete a monitoring and reporting program to ensure the objective of this Opinion is met, to minimize the likelihood of take from activities that result in**

stormwater runoff with the potential to affect water quality and hydrology in streams with listed salmonids.

<u>Terms and Conditions</u>

1. **To implement Reasonable and Prudent Measure #1, the (Federal action agency) shall:**

   a) **Use a subwatershed or landscape approach to look for opportunities to restore natural hydrology.** Examples of this are listed in Table 1 and can include retaining, planting and/or protecting coniferous trees throughout the subwatershed, protecting headwaters and wetlands, and removing impervious surfaces. Areas of natural vegetation or sensitive areas that are important for maintaining hydrology over the long term should be protected through an easement or other legal mechanism. On individual projects, concepts from zero to low impact development and green streets should be incorporated. [This term and condition would be most effective for programs rather than individual projects]

   b) **Develop and implement a Stormwater Management Plan.** For any action that predicts effects to hydrology and water quality as a result of stormwater runoff, a Stormwater Management Plan must be prepared that incorporates measures developed to minimize impacts to the hydrologic cycle and water quality. The Stormwater Management Plan should vary in size and complexity depending on the nature of the proposed action.

      The Stormwater Management Plan must include the following components: [this can be altered by NOAA Fisheries depending on the scope of the proposed action]

      1. **Incorporate concepts from Table 1 that minimize or avoid impacts to the hydrologic cycle and water quality.** Applicants should demonstrate measures from Table 1 have been considered and provide a narrative discussing specific measures incorporated into the project. If measures are not incorporated into the project, a rationale should be provided. Examples of measures from Table 1 include:

         A. Stormwater must be infiltrated or dispersed onsite to the maximum extent possible without causing flooding, erosion impacts, or negative effects to groundwater. Where appropriate, based on site conditions (infiltration capacity, etc.), sheet flow should be directed to adjacent vegetated areas. Use of biofiltration and bioretention techniques is recommended. Native vegetation should be built into the project design.

         B. Any project that will produce new impervious surfaces or land use conversions that retard the entry of water into the soil or decrease evapotranspiraton, must control the quantity and quality of the resulting stormwater runoff for the life of the project.

C. Install engineered BMPs for stormwater flow control and treatment after landscape approaches have been incorporated into the project, and project effects remain. The purpose of the BMPs is to minimize, retain, treat, and infiltrate stormwater on-site to the maximum extent possible without causing flooding, erosion, or water quality effects.

D. Runoff from pollution generating surfaces (including bridge decks) must be pre-treated to reduce suspended solids and non-point source pollutants before use of infiltration BMPs.

E. Stormwater BMPs installed in the riparian buffer area or within a wetland will require a written approval of NOAA Fisheries.

F. Permeable pavements must be installed and maintained for load-bearing surfaces, including multiple-use trails, wherever feasible based on soil, slope, and traffic conditions. Examples of permeable surfaces include porous asphalt or concrete, and permeable interlocking pavement.

G. When runoff must be discharged into a freshwater or marine system, and overland flow through riparian corridors would be considered inappropriate (e.g., cause erosion), the following requirements apply.

- For projects discharging to large water bodies, the area must be drained by a conveyance system comprised entirely of manufactured elements (e.g., pipes, ditches, outfall protection) that extends to the ordinary high water line of the receiving water.
- No construction discharge water may be released within 1000 feet upstream of active spawning areas, or areas with marine submerged vegetation (monitoring required), or known baitfish spawning areas (baitfish include: Pacific herring, sandlance and smelt.
- Any erodible elements of this system must be adequately stabilized to prevent erosion.
- If construction discharge water is released using an outfall or diffuser port, velocities must not exceed 20 cm/sec.
- Runoff treatment facilities must be designed, built, monitored and maintained to collect and treat runoff from the project site, including bridges, using the best available technology applicable to the site conditions. Treatment must be provided to remove debris, nutrients, sediment, petroleum hydrocarbons, metals and other pollutants likely to be present.

2. **During construction, prevent pollutants from entering stormwater runoff.** For many projects and programs, this will require the development of an Erosion Prevention and Sediment Control Plan (Plan). This Plan would augment the Stormwater Management Plan, with a special focus on minimizing or avoiding the movement of sediment,

particularly into waterbodies. [This term and condition is designed to require the incorporation of effective erosion control into project design and implementation. Effective erosion control has two components: the prevention of soil movement and sediment retention and treatment measures. Measures for preventing soil movement include following seasonal work limitations, phasing construction to limit the extent of exposed soils, and temporary and permanent seeding, sodding, and mulching. Sediment retention measures include filter bags, sediment traps, catch basin inserts, and systems designed to remove sediment from suspension before leaving the site. The goal of these measures is to prevent sediment from reaching waters which support listed salmonids.]

Facilities must be designed, built, monitored and maintained to collect and treat all construction discharge water using the best available technology applicable to site conditions. The treatment must remove debris, nutrients, sediment, petroleum hydrocarbons, metals, and other pollutants likely to be present, and must address activities such as clearing, grading, stockpiling, filling, earthwork, excavation, demolition, and others.

(The Federal action agency) must look for opportunities for source control. For example, the project timing should be adjusted to avoid the rainy season. One jurisdiction in California is working with car brake manufacturers since copper from brake linings were found to be a significant source of copper in stormwater. Integrated pest and nutrient management programs to avoid or minimize toxic chemical use are also good examples of effective source control. [This term and condition would be effective for both programs and individual projects]

3. **Minimize alteration of natural soils and vegetation.** Minimize soil compaction and removal. Clearly define project limits on the ground to minimize vegetation removal and soil compaction. If alteration of soils and vegetation is necessary, replacement of soils and/or vegetation may be required.

4. **If designed (i.e. engineered) facilities are needed to minimize or avoid effects to hydrology and water quality, continuous rainfall/runoff models must be used to calculate the facility design.** [The goal for post-project discharge durations is to match the pre-project durations for the range of pre-project discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. The goal for water quality is to minimize water quality effects to listed salmonids such that take is avoided or minimized.]

2. **To implement Reasonable and Prudent Measure #2 (monitoring), the (Federal action agency) shall:**

1. **Implementation monitoring. Ensure that a monitoring report is submitted within 120 days of project completion [or program implementation] describing the success of implementing and meeting permit conditions. This shall include review of the Stormwater Management Plan. The monitoring report will include the following information.**
   1. Project identification, including the permittee name, project name and location (by 5th field HUC and/ or WRIA basin name and stream number), and starting and ending dates for work completed.
   2. A narrative assessment of the project's effect on natural stream function.
   3. Photo documentation, including habitat conditions pre-construction, during, and post-construction. Each photo should have appropriate labels (date, time, project name, location, facing direction).
   4. Include other site-specific information, as appropriate.

b. **Effectiveness monitoring. Gather any other data or analyses the (Federal action agency) deems necessary or helpful to complete an assessment of habitat trends in hydrology and water quality as a result of permitted actions. Existing or other on-going monitoring efforts can be used if those data provide information specific to identifying trends in water quality and hydrology. If the project includes designed facilities, the monitoring must demonstrate that the facility is operating as designed.**

c. **Submit monitoring reports to: [**one or more of the following**]**

Branch Chief - Portland
NOAA Fisheries
Attn: OSB200_-____
525 NE Oregon Street
Portland, OR 97232

Branch Chief -Lacey
NOAA Fisheries
Attn: WSB200_-____
510 Desmond Drive, SE, Suite 103
Lacey, WA 98503

Branch Chief - Idaho
NOAA Fisheries
Attn: ISB200_-____
0215 W. Emerald, Suite 180
Boise, ID 83704

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Appendix A
Properties and Processes of Watersheds Most Sensitive to Stormwater Effects

Hydrology

The amount of physical space available to rearing juveniles and adult salmonids in streams and the quality of that habitat is directly related to stream flow discharge. Within stream environments, salmonids select specific micro-habitats where water depth and velocity fall within a specific range or where certain hydraulic properties occur. These preferences in depth and velocity change both with life stage and season.

For many salmonids, smaller-sized fish tend to select shallow, slower moving waters than larger individuals. Newly emerged fry may be vulnerable to downstream displacement by flow and typically select velocities lower than 10 cm/s. Spawning salmonids tend to select spawning sites based on stream velocities, depth, and upwelling. The survival of migrating adults and juveniles, as well as eggs in redds during the incubation period, are also flow dependent.

For resident salmonids and juvenile anadromous species that spend a year or more in freshwater, stream flow during the summer low-flow period must be adequate to prevent streams from becoming excessively warm or drying up altogether. Under low baseflow conditions, surface streamflow may become intermittent, and fish may be restricted to isolated pools. Such conditions can result in increased competition for food, reduced dissolved oxygen levels, increased physiological stress, and vulnerability to predators. Deep pools with groundwater inputs provide the necessary cover and thermal refugia.

During summer months, salmonids often select holding positions at moderate velocities immediately adjacent to faster waters. The amount of food delivered to a particular location is proportional to water velocity. Consequently, fish that hold in water adjacent to faster water can maximize food intake while minimizing energy expenditures associated with maintaining position in the current. Changes in the hydrology and geomorphology of streams can affect the hydraulic environment of streams, altering the velocity profiles and hyorheic/parafluvial dynamics of channels. Such changes would affect many ecological processes, from filter-feeding organisms (Hart and Finelli 1999) to carbon processing and nutrient cycling (Jones and Mulholland 2000).

Land conversions significantly influence hydrologic processes, increasing the magnitude, frequency and duration of peak discharges and reducing summer base flows (Booth 1991). These changes occur because of a loss of forest cover, and an increase in the impervious surface, and a replacement of the natural drainage system with an artificial network of storm pipes, drainage ditches and roads (Lucchetti and Fuerstenberg 1993, Booth and Jackson 1997). Roads provide a direct drainage pathway for runoff into the stream system and storm sewer outfalls. Reductions in the natural drainage network and increases in artificial drainage systems shrink the lag time between a rainfall event and the point of peak discharge of stormwater into a stream (Booth and Jackson 1997). This reduction often equates to heightened stormwater peak discharges which cause streambed and streambank scour, mobilize and remove large wood, and extend durations of channel forming flows. This change to the natural hydrology of the stream can have adverse effects on all life stages of salmonids, however, rearing juveniles are particularly vulnerable to being swept downstream during high flows and flows of extended durations.

The increased impervious cover of urbanized watersheds also alters the pathway of water to streams. As functional vegetation is removed, evapotranspiration (evaporation of water from plant surfaces and transpiration of water from the soil by plants) can be decreased by 50% or more, resulting in increased runoff volume. Infiltration is reduced as soils are stripped of vegetation, compacted and/or paved, and impervious cover increases. This decrease in infiltration often results in a decrease of stream base flows, adversely affecting salmonids who utilize streams during the summer.

Streams adjust their channel dimensions in response to long-term changes in bankfull discharge and sediment supply associated with urbanization (Dunne and Leopold 1978). Initially, channels aggrade as the sediment supply increases. The decreased channel capacity leads to greater flooding and overbank sediment deposits, resulting in raised bank heights. After the sediment supply is reduced, a second erosional geomorphic adjustment occurs. Increased flows begin eroding the channel and a general deepening and widening of the channel (channel incision occurs to accommodate the increased bankfull discharge. After incision, channels begin to migrate laterally, bank erosion begins, which leads to general channel widening (Dunne and Leopold 1978, Booth and Jackson 1997). Besides creating unstable streambed substrate which affects salmonid spawning, channel widening can also result in loss of riparian vegetation and removal of large wood.

<u>Water Quality</u>
Water temperature, turbidity, dissolved oxygen (DO), pH, nutrients, and toxic chemicals/metals, all affect water quality and the ability of surface waters to sustain listed salmonids. Each of these factors exhibits natural daily or seasonal fluctuations in magnitude or concentration, and when coupled with the effects of development and stormwater runoff, can exceed the natural range of these factors and alter or impair biological processes.

Of these factors, temperature is perhaps the most important influence on salmonids, affecting the body temperatures of all aquatic organisms and their metabolic demands, including food requirements, growth and development rates, timing of life history events, and predator-prey and competitor interactions. In developed areas streamside vegetation is often removed and groundwater inputs are reduced, causing an increase in summer stream temperatures and a decrease in winter water temperatures (Klein 1979).

Siltation and turbidity adversely affect fish at every stage of their life cycle (Iwamoto et al. 1978). Turbidity abrades and disrupts fish gills and affects light penetration which in turn affects salmonid feeding behavior. These effects are exacerbated by the loss of vegetation and alteration of soil structure that occurs with development, and results in increased sediment delivery to streams. In addition, the amount of sediment and rate of transport of sediment through stream systems is increased with the addition of stormwater runoff–6 times greater in a western Washington stream (Richey 1982).

All salmonids require high levels of DO, which are available in most natural situations. Reduced levels can affect the growth of embryos, alevins, and fry, and the swimming ability of migrating adult and juvenile salmonids. In developed environments, stormwater runoff may reduce DO concentrations by carrying large amounts of organic debris (yard waste, leaf litter) and nutrient enrichment (from sewage treatment and agricultural runoff) into streams. In addition, high stream temperatures associated with urban streams, may also decrease DO concentrations (Spence et al. 1996).

The effect of pH on salmonids is influenced by watershed characteristics and concentrations of dissolved materials in surface waters. However, surface water acidity frequently results from anthopogenic activities related to land use. Low pH adversely affects salmonids by causing respiratory problems for fish, and increasing the mobility and bioavailability of metals to aquatic organisms (Spence et al. 1996).

Nutrients, chemicals and metals are potentially widespread in the environment, and surface and groundwaters may be affected by activities that occur with increased development in a basin. In urban streams during storm events, nitrogen and phosphorus are available in some instances at levels that equal or exceed that of sewage effluent (Pitt and Bozeman 1980), with the annual export of nitrogen and orthophosphate from urban streams being 8 and 3 times greater, respectively, than in streams draining forested watersheds (Omernick 1977). This increase in nitrogen and phosphorus comes primarily from wastewater discharges and fertilizer use, and the result can be increased primary productivity elevated to nuisance levels, increasing oxygen demand and decreasing DO levels in the stream. Pesticides are often detected in urban streams at concentrations that frequently exceed guidelines for the protection of aquatic biota (USGS 1999a, Hoffman et al. 2000). Sublethal effects such as neurological behavioral effects stemming from standard rates of application of pesticides area a concern. Environmentally relevant concentrations of diazinon (USGS 1999b) has been show to disrupt homing and anti-predator behaviors in chinook salmon (Scholtz et al. 2000). Other organic contaminants in urban streams include polychlorinated biphenyls (PCB's), polycyclic aromatic hydrocarbons (PAH's), and petroleum-based aliphatic hydrocarbons, all frequently found at levels exceeding human health criteria or at levels stressful to sensitive aquatic organisms (Paul and Meyer 2001). Natural metal concentrations in surface water vary regionally, however, a common feature of urban streams is elevated water column and sediment metal concentrations, including lead, zinc, chromium, copper, manganese, nickel and cadmium, which increase with increased percentages of urban land use (Wilber and Hunter 1979). In addition to industrial discharges, other sources of metals are brake linings, tires, and metal alloys for engine parts. Although some metals are necessary trace nutrients, many metals are toxic to fish at very low concentrations (Spence et al. 1996).

<u>Biotic Integrity</u>

The diversity, richness, and composition of the benthic or streambed community has frequently been used to evaluate the quality of streams. Not only are aquatic insects a useful environmental indicator, they also are an important component of the food web in lowland rivers and streams. The diversity of macroinvertebrate communities drops sharply in urban streams in response to toxins, temperature change, siltation, organic nutrients, and loss of physical complexity. The loss of diversity is most dramatic when watershed imperviousness exceeds 10 to 15 percent (Jones and Clark 1987, Horner et al. 1997, Booth and Jackson 1997). Sensitive macroinvertebrates are replaced by species that are more tolerant of pollution and hydrologic stress (Thorne et al. 2000). Species such as stoneflies, mayflies, and caddisflies largely disappear and are replaced by chironomids, tubificid worms, amphipods, and snails. Species that employ specialized feeding strategies — shredding leaf litter, grazing rock surfaces, filtering organic matter that flows by and preying on other insects — usually disappear first.

Habitat Elements

Salmon survival and production are reduced as fine sediment increases, producing multiple negative impacts on salmon at several life stages. Increased fine sediment entombs salmon embryos incubating in redds, reduces egg survival by reducing oxygen flow, alters the food web, reduces pool volumes for adult and juvenile salmon, and reduces the availability of rearing space for juveniles rendering them more susceptible to predation. Reduced survival-to-emergence for salmon caused by elevated fine sediment is of particular concern because it is a source of density-independent mortality that can have extremely significant negative effects on salmon populations even at low seeding. The rearing capacity of salmon habitat is decreased as cobble embeddedness levels increase (Brusven and Prather 1974). Overwintering habitat may be a major limiting factor to salmon production and survival. Backwater areas important for winter rearing are frequently lost in urban watersheds because of the channelization of streams and the geomorphological changes associated with the higher peak flows. The loss of overwintering habitat may result in increased levels of mortality during rearing life stages.

Large wood (LW) interacts with natural channel-forming features such as boulders or bedrock to create different types of pool habitats and to increase hydraulic heterogeneity (Swanson et al. 1976). The hydraulic heterogeneity and habitat complexity associated with LW allows multiple species to coexist as an assemblage. LW and associated pool habitats provide cover from predators and refuge habitats during storm events. LW can serve as a collection point for small woody debris and leaf litter, from this material important prey species can be supported (Bisson et al. 1987). Watersheds with more than 20% impervious cover generally have very little LW (Finkenbine et al. 2000).

The spacing between pools and riffles is generally pretty constant at 5-7 times channel width in forested subwatershed (Gregory et al. 1994). There is some evidence that the spacing may decrease in channels as they widen during the aggradation phase of channel destabilization associated with urbanization.

In general, habitat rather than food is the limiting resource for most salmonids (Spence et al. 1996). Food production and predator avoidance is linked directly to the quantity and quality of available habitat (including associated wetlands and riparian forest). In lowland streams, rearing habitat appears to be limiting. In the summer, coho rear primarily in pools with high habitat complexity and abundant cover, typically associated with LW as the main structural component. In the winter coho prefer side channels, sloughs, or beaver ponds. Juvenile chinook are typically found in glide and riffle habitats with faster waters than typically used by coho, though chinook do use pool habitats when available. Backwaters and side-channels that developed along unconstrained reaches in alluvial flood plains were historically important rearing habitats for many salmonid juveniles and where these habitats remain intact they often contribute a disproportionate share of total salmonid abundance. Habitat segregation seems to be a mechanism for reducing competition between species rather than a result of competition (Groot and Margolis 1991). Urbanization tends to reduce pool area, habitat complexity, and LW. Reductions in complexity can result in loss of opportunities to segregate and, therefore, increase competition between species.

Riparian Condition

When utilities or roads cross over a stream, the result is a break in riparian vegetation and riparian function. Breaks in riparian vegetation are effective conduits for stormwater runoff which contribute to the decrease in lag time between a rainfall event and peak stormwater discharge. Crossings which do not have water quality controls on surface runoff degrade water quality in the receiving water. Road densities and stream crossings exert a greater hydrological impact on streams than roof-top runoff (Schueler 1994, May et al. 1997).

Riparian deforestation associated with urbanization and agricultural practices alters the hydrologic cycle through reduced evapotranspiration (Paul and Meyer, 2001), reduces food availability, affects stream temperature, and disrupts sediment, nutrient, and toxin uptake from surface runoff. Invertebrate bioassessment metrics decreased sharply in Puget Sound tributaries with increasing impervious surface cover (Horner et al. 1997). However, streams that had higher benthic index of biotic integrity scores for a given level of impervious surface cover were always associated with greater riparian forest cover in their subwatershed, suggesting that riparian zones in some urban subwatersheds may buffer streams from urban impacts. Riparian protection only goes so far in protecting against effects from urbanization. Impervious surface cover above 30% causes significant stream degradation, regardless of riparian status.

In addition to minimizing effects from urban stormwater runoff, a healthy riparian structure performs a number of vital functions that affect the quality of salmonid habitats. The health of aquatic systems is inextricably tied to the integrity of the riparian zone. Riparian vegetation provides numerous functions including shading, stabilizing streambanks, controlling sediments, provides an on-going source of LW and organic litter, and regulates the flux and composition of nutrients. A healthy riparian area is comprised of a mixture of mature conifers and deciduous trees. A riparian area dominated by blackberries and exotic vegetation will not preform the functions described above.

Channel Morphology and Connectivity

The floodplain provides temporary storage space for floodwaters and sediment produced and delivered from higher up in the watershed. Often associated with the floodplain are wetlands and oxbow lakes. Some of these wetlands remain hydrologically connected to the stream channel with intermittent or year-round surface flow, others are connected by subsurface flow through the streams hyporheic zone. These wetlands provide valuable over-wintering habitat for juvenile salmonids, produce prey organisms and serve as refugia habitat (Cederholm 1994). Floodplain connection is also important in defining a river or streams channel and the ability for the stream to migrate and cut new channels. Maintaining the streams ability to migrate in its floodplain provides a continuing source of sediments, LW and creation of abandoned channels which later serve as side channels for additional rearing and over-wintering habitat.

Historically when a watershed was urbanized, the stream is channelized and the off-channel habitats and wetlands are disconnected and frequently filled. As riparian areas are developed, vegetation is removed, and soils become compacted or are paved. As a result, the stream becomes increasingly disconnected from its floodplain.

Undersized culverts and in some instances bridge abutments effectively confine a river, thus reducing channel width, increasing channel depth, altering velocity, and resulting in a host of physical, chemical and biological responses. During high flow periods these structures can become obstructions to upstream migration for juvenile and adult salmon. Poorly designed or installed culverts can also provide blockages to juvenile or adult migration during low flow periods. Either condition effectively reduces utilization of upstream habitat by salmonids during different life phases.

Basin Condition

Imperviousness is a very useful indicator with which to measure effects of land development on aquatic systems. Total impervious area is a physically defined unit which is the sum of roads, parking lots, sidewalks, rooftops, and other impermeable surfaces of the lowland streams landscape. Several studies have provided significant scientific evidence that relates imperviousness to specific changes in hydrology, habitat structure, water quality and biodiversity of aquatic systems. The body of research — conducted in many geographic areas, concentrating on many different variables, and employing widely different methods — has yielded similar conclusions: significant stream degradation can occur at relatively low levels of imperviousness (Paul and Meyer 2001). The hydrology of urban streams changes as sites are cleared and natural vegetation is replaced by impervious cover. One of the consequences is that more of a stream's annual flow is delivered as storm water runoff rather than baseflow. Depending on the degree of a subwatershed's impervious cover, the annual volume of storm water runoff can increase by up to 16 times that for natural areas (Schueler 1994). Increased stream flows can have significant effects on channel morphology. In addition, since impervious cover prevents rainfall from infiltrating into the soil, less flow is available to recharge ground water. Therefore, during extended periods without rainfall, baseflow levels are often reduced in urban streams.

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Appendix B
DRAFT Matrix of Pathways and Indicators for Lowland Streams

To determine whether a proposed or continuing action is likely to jeopardize a listed species or destroy or adversely modify its critical habitat, it is first necessary to define the biological requirements for ensuring the continued existence (in terms of survival and recovery) of the species. Anadromous salmonid biological requirements can be expressed in terms of environmental factors that define properly functioning freshwater habitat necessary for survival and recovery of the proposed/listed species. These environmental factors are known to result in sufficient prespawning survival, egg-to-smolt survival, and upstream/downstream migration survival rates to ensure survival and recovery of listed species (Reiser and Bjornn 1979, Irving and Bjornn 1984, Cuenco and McCullough 1995). Individual environmental factors include: water quality, habitat access, physical habitat elements, channel condition, and hydrology. The lowlands matrix is divided into seven overall pathways designed to summarize these important environmental parameters (Table 1). This matrix will best describe the existing baseline conditions of the environmental factors listed above.

For the jeopardy determination, NOAA Fisheries uses the consultation regulations, these guidelines, and the MPI analysis method to determine whether actions would further degrade the environmental baseline or hinder attainment of properly functioning conditions (PFC) at a spatial scale relevant to the listed species. That is, because salmon evolutionary significant units (ESUs) typically consist of groups of populations that inhabit geographic areas ranging in size from less than ten to several thousand square miles (depending on the species), the analysis must be applied at a spatial resolution wherein the actual effects of the action upon the species can be determined.

The analysis takes into account the species' status because determining the impact upon a species' status is the essence of the jeopardy determination. Depending upon the specific considerations of the analysis, actions that are found likely to impair currently properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat towards PFC at the population or ESU scale will generally be determined likely to jeopardize the continued existence of listed salmon, adversely modify their critical habitat, or both. Specific considerations include whether habitat condition was an important factor for decline in the listing decision, changes in population or habitat conditions since listing, and any new information that has become available.

The matrix developed here reflects information needed to evaluate urban, suburban and agricultural effects on properly functioning conditions in lowland rivers and streams.

Using these tools, the Federal agencies and non-Federal Parties (referred to as evaluators in the remainder of this document) can make determinations of effect for proposed projects (i.e. "no effect"/"may effect" and "may affect, not likely to adversely affect"/"may affect, likely to adversely affect"). These determinations of effect will depend on whether a proposed action (or group of actions) hinders the attainment of relevant environmental conditions (identified in the matrix as pathways and indicators) and/or results in "take," as defined in ESA, section 3 (18) and 50 CFR Part 222, of a proposed or listed species.

Description of the Lowland Matrix

The draft lowland matrix of pathways and indicators (Table B-1) is designed to summarize important environmental parameters and levels of condition for each within the transitional and lowland portion of a river system. The transitional zone is immediately below headwater areas. This zone receives some of the bedload material carried down from the headwater sources, it is usually characterized by wide a floodplain and meandering channel patterns. The gradient flattens in the lowland portions and is primarily a sediment depositional zone, channels become very braided and have wide meandering bends.

This matrix is divided into seven overall pathways:

–Water Quality – Flow Hydrology – Habitat Elements
– Biotic Integrity – Basin Conditions – Riparian Condition
– Channel Condition & Dynamics

Each of the above represents a significant pathway by which actions can have potential effects on anadromous salmonids and their habitats in the transitional and lowland portions of a river system.

The pathways are further broken down into "indicators." Indicators are generally of two types: (1) Metrics that have associated numeric values; and (2) descriptions (e.g. "Off-channel areas are frequently hydrologicly linked to main channel"). The purpose of having both types of indicators in the matrix is that numeric data are not always readily available for making determinations (or there are no reliable numeric indicators of the factor under consideration). In this case, a description of overall condition may be the only appropriate or reasonable method available.

The columns in the matrix correspond to levels of condition of the indicator. There are three condition levels: "properly functioning," "at risk," and "not properly functioning." For each indicator, there is either a numeric value or range for a metric that describes the condition, a description of the condition, or both. When a numeric value and a description are combined in the same cell in the matrix, it is because accurate assessment of the indicator requires attention to both.

Table B-1. DRAFT matrix of pathway and indicators for transitional and lowland streams, with an emphasis on pathways relevant to effects associated with land conversions and stormwater.

Pathway	Indicators	Environmental Baseline: Properly Functioning	Environmental Baseline: At Risk	Environmental Baseline: Not Properly Functioning	References
Water Quality Within the subwatershed	Temperature a) spawning & incubation:	7 day mean of daily max. ≤ 13°C; weekly mean ≤ 10°C.	7 day mean of daily max. 13 – 15°C.	7 day mean of daily max. > 15°C.	Spence *et al*. 1996;
	b) juvenile rearing	7 day mean of daily max. ≤ 16°C; weekly mean ≤ 15°C.	7 day mean of daily max. 16 – 18°C.	7 day mean of daily max. > 18°C.	
	c) steelhead smoltification	7 day mean of daily max. ≤ 14°C; weekly mean ≤ 12°C.	7 day mean of daily max. 14 – 16°C.	7day mean of daily max. > 16°C.	
	d) adult migration	7 day mean ≤ 18°C; weekly mean ≤ 16C.	7 day mean of daily max. ≤ 18 – 20°C.	7 day mean of daily max. > 20°C.	
	Dissolved Oxygen a) Water column minimum:	8 mg/L	6 – 8 mg/L	< 6 mg/L	
	b) 7-day mean minimum at spawning & incubation:	> 11mg/L	9 – 11 mg/L	< 9 mg/L	
	pH	pH between 6.5 and 8.5	pH between 6.0 and 6.5 or between 8.5 and 9.0	pH less than 6.0 or greater than 9.0	1999 Biological Opinion, OSB 1999-0146
	Nutrients, Toxicity and Turbidity	Subwatershed meets water quality standards for all parameters. No CWA 303(d) reaches. No excess nutrients, turbidity or toxicity.	Water quality in the subwatershed has one parameter exceeds the water quality criteria by 10% or greater. A reach may be designated as 303(d) reach for no more than one parameter.	More than one parameter exceeds water quality criteria by 10% or greater. More than one parameter on the 303(d) list. Sublethal and lethal effects from toxics.	

Flow Hydrology Within the basin	Peak Flow (flow variation/duration)	Basin hydrograph indicates peak flow and flow timing and duration characteristics comparable to an undisturbed basin of similar size, geology and geography	Some evidence of altered peak flow and/or flow timing and duration relative to an undisturbed basin of similar size, geology and geography	Pronounced changes in peak flow and/or flow timing and duration relative to an undisturbed basin of similar size, geology and geography	
	Base Flow conditions	Basin hydrograph indicates base flow characteristics comparable to an undisturbed basin of similar size, geology and geography.	Some evidence of altered base flow relative to an undisturbed basin of similar size, geology and geography.	Pronounced changes in base flow relative to an undisturbed basin of similar size, geology and geography.	1
	Drainage Network	Zero or minimum increases in drainage network density due to development	Moderate increases in drainage network density due to development (e.g., approx. 5%)	Significant increase in drainage network density due to development (e.g., approx. 20-25%).	2
Biotic Integrity Within the reach, downstream of project.	Biota (B-IBI) September sampling (ideally in the reach downstream of the proposed action).	Score greater than 33 B-IBI	25 – 32 B-IBI	< 25 B-IBI	
Habitat Elements	Substrate within the reach	Dominant substrate is gravel or cobble, interstitial substrate is clear, or embeddedness < 20 %	Gravel and cobble is subdominant, or if dominant, embeddedness 20 – 30%	Bedrock, sand, silt or small gravel dominant, or if gravel and cobble dominant, embeddedness > 30%	
	Number & Quality of LWD within the basin. Separate upstream conditions (recruitment potential) from downstream LW conditions.	0.3-1.0 piece/channel width for streams < 10 m wide. 0.5-1.5 piece/channel width for streams 10-20 m wide.	Currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain standard	Does not meet standards for properly functioning and lacks potential large wood recruitment in riparian area for several decades.	mod. Per ML
	Off-channel Habitat Downstream from project.	Backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.	Some backwaters and high energy side channels	Few or no backwaters, no off-channel ponds	

Habitat Elements (continued)	Refugia Downstream from project	Habitat refugia exist and are adequately buffered (e.g., by intact riparian reserves); existing refugia sufficient in size, number and connectivity to maintain viable populations or sub-pop.	Habitat refugia exist but are not adequately buffered (e.g., by intact riparian reserves); existing refugia are insufficient in size, number and connectivity to maintain viable populations or sub-populations	Adequate habitat refugia do not exist	
	Pool Frequency* Downstream from project	Meets pool frequency standards, and large wood standards in MPI for properly functioning habitat	Meets pool frequency standards but LW recruitment inadequate to maintain pools over time	Does not meet pool frequency standards.	Applies only to unconfined streams?
	Pool Depth / Quality Downstream from project	> 1 m deep (holding pools) with good cover and cool water, minor reduction of pool volume by fine sediment	0.5 – 1.0 m fewer deeper pools present or inadequate cover/temperature, moderate reduction of pool volume by fine sediment.	< 0.5 m deep. No deep pools and inadequate cover/temp., major reduction of pool volume by fine sediment.	Applies only to unconfined streams?
Basin Conditions	Percent TIA in the basin	0 – 5%	> 5% and < 15%	> or equal 15%	Horner & May
	Percent Forested within the basin	> 65% in hydrologically mature forest	50 – 65 % in hydrologically mature forest	< 50% in hydrologically mature forest	
Riparian Condition in the basin	Riparian Structure within the reach upstream and downstream of the project	75% of riparian at least SPTH in width; & 85% of overall riparian zone in forest or wetland cover	50 – 75% of riparian at least SPTH in width; & 50 – 85% of overall riparian zone in forest or wetland cover	< 50% of riparian at least SPTH in width; < 50% of overall riparian zone in forest or wetland cover	
	Stream Crossings/ km	< 2 20m breaks per km of stream	2 – 4 20 m breaks/km of stream	> 4 20 m breaks/km of stream	
Channel Condition And Dynamics	Stream bank Condition within the reach downstream of the project.	> 95% in functional condition (unarmored)	75 – 95% in functional condition (unarmored)	75% or less in functional condition (unarmored)	

	Channel Morphology (indicator here is a placeholder, PFC language being developed)				
Channel Condition and Dynamics (cont.)	Hydraulic Constrictions or Blockages within the basin – differentiate between upstream and downstream conditions. (my draft criteria, needs technical support)	No artificial hydraulic constrictions (poorly designed culverts or bridges) that would disrupt upstream and downstream year-round migration of juvenile or adult salmon	Hydraulic constrictions exist but allow for year-round access to at least 80% of potential spawning and rearing habitat.	Hydraulic constrictions exist and limits access to greater than 20% of potential spawning and rearing habitat.	
	Floodplain Connectivity within the basin.	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly	
	Wetland Storage & Alterations within the basin.	> 95% of all historic connecting wetland capacity present and unaltered	70 – 95% of historic connecting wetland capacity present and unaltered	< 70% of historic connecting wetland capacity present and unaltered	

1 indicates this pathway/indicator is directly out of the original NOAA Fisheries MPI. Repeated here to emphasize the importance relative to potential stormwater effects. Applicants are expected to use the original MPI as well to describe environmental baseline and all other (non-stormwater related) effects from the proposed action.

Appendix C
Regional Differences and State Regulatory Approaches to Stormwater

This guidance has been developed based on studies and data from western Washington and Oregon. The applicability of the guidance to arid regions of eastern Washington and Oregon is not known at this time; however, we can hypothesize about how regional differences in climate, soils, vegetation and infrastructure can affect stormwater runoff, and consequently streams and rivers.

Because of climatic differences between the east and west side of Oregon and Washington, physical and biological conditions and processes vary as well. In the arid regions of these states, forested, riparian and wetland conditions have been greatly altered, and provide little filtration for the interception of contaminants and diffuse runoff. Basin hydrology has been altered by irrigation and flow controls at dams. Altered stream flow and degraded water quality have been factors contributing to the decline of native salmonids in eastern Washington and Oregon.

In eastern Oregon and Washington, the bulk of the fall and winter precipitation tends to fall as snow. On roads and developed areas the snow gets blown, plowed or stockpiled at makeshift locations, and is allowed to melt and run off, or infiltrate on-site. The snow collected from road surfaces is often laced with anti-icing compounds (salts), dirt/sand, and often has direct access to creeks and rivers as spring melt occurs. Virtually all bridge crossings over waterways are pathways for this untreated delivery. Many street culverts are designed to transport the runoff to feeder tributaries or directly to the mainstem rivers.

Most of the towns in eastern Oregon and Washington have old or antiquated sewage treatment facilities, and are not equipped to handle huge surges of runoff associated with summer rain events. Riparian zones in most of the eastern lowland areas tend to be confined to the immediate bank area, and are generally not much wider than a few alder or cottonwood trees. Outside the riparian zone, the arid environment supports mainly steppe-sage vegetation. Soils tend to be highly erosive, especially when the vegetation and root zones are disturbed or removed. This condition is not confined only to development, but is also common to grazing, ranching, farming and orcharding operations, further exacerbating surface water runoff, along with the contaminants associated with those operations such as fecal coliform, chemical additives, pesticides, and herbicides.

Over the next few years, NOAA Fisheries will encourage an adaptive management approach (continuously improving management policies and practices by learning from the outcomes of projects) to adjust stormwater best management practices to the arid conditions and infrastructure typical of eastern Oregon and Washington. The same approach will be used to expand the utility of this guidance into arid regions of California, and all of Idaho. In Washington state, the Department of Ecology is in the process of developing a stormwater management manual for eastern Washington that will specify best management practices for that environment. At a minimum, we expect that the manual will provide useful information for further developing a section of this guidance for eastern Oregon and Washington.

Washington

NOAA Fisheries has not formally consulted on a stormwater program, ordinance or law in the State of Washington for sufficiency to meet the Endangered Species Act for salmon. However, NOAA Fisheries provided feedback on the Washington State Department of Ecology's (Ecology) revisions to the Stormwater Management Manual for Western Washington, and some technical concerns were addressed in the Final Manual. In addition, NOAA Fisheries provided feedback to several local jurisdictions (the Tri-County Coalition) who were interested in pursuing a 4(d) limit under limit 12 (Municipal, Residential, Commercial and Industrial Development) that included a stormwater component. NOAA Fisheries has reviewed projects under section 7 of the ESA that have effects to habitat as a result of stormwater runoff. In Western Washington, a common approach has been to rely on the requirements of the 2001 Manual, recognizing that in some instances these requirements will not protect listed species (e.g., when baseflows are degraded and infiltration is not feasible). Low impact design approaches have been rare, although jurisdictions are more frequently implementing natural watershed features and processes to minimize or avoid stormwater effects from their projects.

In Washington State, the Environmental Protection Agency (EPA) has delegated authority to Ecology to issue Phase I and Phase II National Pollutant Discharge Elimination System (NPDES) permits, as well as Industrial and Construction Stormwater permits, to implement the Clean Water Act (CWA). In 1995, Ecology issued Phase I permits to 6 jurisdictions and the Washington State Department of Transportation (WSDOT), which required compliance with the 1992 Ecology Stormwater Manual. Ecology is re-issuing these permits with a requirement to comply with the 2001 manual by 2003. Ecology will issue a general permit rule for Phase II municipalities (expected to include ~ 78 to 96 local jurisdictions) and construction activities by March 2003, which requires adoption of ordinances, minimum requirements and BMP's equivalent to the 2001 Manual, with permit coverage required by March 2004.

There are approximately 1,400 facilities covered under Ecology's Industrial Stormwater Permits issued in November of 2000, which required implementation of operational, source control, erosion and sediment control, flow control, and treatment BMP's. Ecology expects to issue a revised permit by March 2003, which incorporates applicable Phase II regulations. Ecology has also issued permits for construction sites of five acres or more, which has included 350 to 700 sites seasonally, requiring stabilization and structural practices to reduce erosion and discharge of sediments. Ecology will issue a revised permit by March 2003, which will apply to sites of one acre or more, and incorporate applicable Phase II regulations.

The Puget Sound Water Quality Management Plan (PSWQMP) directs every city and county in the Puget Sound Basin to develop and implement a comprehensive stormwater management program, which includes adoption of ordinances, minimum requirements and BMP's equivalent to the 2001 Manual. Municipalities not subject to the PSWQMP or the NPDES Stormwater permits are encouraged to adopt stormwater programs at least equivalent to the Puget Sound Basic Stormwater program. Municipalities in areas where urban stormwater has been identified as a limiting factor for salmon recovery are expected to have an equivalent stormwater manual as defined by the PSWQMP. However, the PSWQMP has no enforcement capability.

Oregon

NOAA Fisheries has not reviewed a stormwater program, ordinance or law in the state of Oregon for sufficiency to meet survival and recovery of salmon. NOAA Fisheries has reviewed projects under section 7 of the ESA that have effects to habitat as a consequence of stormwater runoff. Approaches have varied between projects depending on the location and the action agency. Generally the approach used has been to detain flow to the standard applied by the local municipality, and treat the water through bioswales or engineered treatment facilities. Low impact design approaches have been rare.

Oregon Department of Environmental Quality (DEQ) regulates 1200C construction permits for stormwater throughout the state, although DEQ contracts with some local jurisdictions (e.g. Eugene) to implement portions of the program. DEQ retains enforcement authority and registers sites for permit coverage. DEQ also issues other stormwater permits under the NPDES program. In Oregon, 1640 facilities are covered by storm water general permits. DEQ has issued seven Phase I Municipal Separate Storm Sewer System Permits (MS4) although most have expired and are awaiting renewal. Phase II communities MS4 permits are expected in 2003. There are a number of other regulatory programs that address storm water discharges in addition to the NPDES permits. The mandatory storm water-related programs include:

- DEQ Phase I MS4 (municipal) storm water individual permits (7, including largest jurisdictions in the state)
- DEQ Phase II Storm Water NPDES MS4 General Permit (proposed)
- DEQ Storm Water NPDES General Permit, 1200 C for Construction Activities (one acre or more of land disturbance)
- DEQ Storm Water NPDES General Permit, 1200-Z for industrial activities
- DEQ Storm Water NPDES General Permit, 1200-A for sand and gravel mining
- DEQ 401 Water Quality Certification Program for Section 404 or Section 10 Fill and Removal Permits with required Storm Water and Erosion Control Plans
- DEQ Underground Injection Control Program with required Storm Water Plan (of the 45,000 registered UICs, about 40,000 are for discharge of storm water)
- Oregon Water Resources Department Water Law (OR 690) which requires adequate levels of instream water to protect water quality and aquatic species and water quality protection of wells through the control of storm water and other pollution sources.
- DEQ Urban TMDL Implementation Plan Guidance for Local Governments with required Storm Water Plan.
- DLCD Oregon State Land Use Planning Program that encourages compact urban growth and low impact development.
- Oregon Coastal Nonpoint Pollution Control Program that ahs management measures that require both erosion and storm water quantity and quality controls for new and existing development within the CNPCP boundary that includes all lands west of the coast Range and the complete watersheds of the Umpqua and Rogue Basins.

DEQ has not issued numeric standards for stormwater compliance. The NPDES Phase 1 MS4 individual stormwater permit is negotiated individually. Structural and non-structural best management practices are the primary focus of permit programs, with an emphasis on pollution prevention. Monitoring is not required to verify BMP effectiveness, although DEQ encourages permittees to use monitoring as a way of determining BMP effectiveness. Emerging water quality and quantity concerns will likely change the focus on the next round of permits, and the incorporation of numeric standards is possible. DEQ's NPDES 1200-Z general permit establishes benchmarks (guideline concentrations) for industry and requires stormwater monitoring that are evaluated against the benchmarks. Industrial and construction stormwater permits require permittees to comply with state water quality standards, which are largely concentration-based numeric standards.

Many local municipalities have developed stormwater standards for their development review process. The standards vary and are difficult to compare because they are designed for different storms (i.e. 2-year versus 5-year) and have different treatment requirements. The standards are developed to meet DEQ NPDES permit requirements, and have not considered the needs of salmon or salmon habitat.

California

The NOAA Fisheries Southwest Region has not reviewed a complete municipal stormwater program in the State of California for sufficiency to meet survival and recovery of listed salmonids. Numerous individual development projects have undergone consultation which considered possible stormwater effects as part of the overall project. A notable consultation was conducted on a wastewater treatment plant expansion of the in the Central Valley of California. This consultation ended informally when the municipality committed to treating all future stormwater resulting from growth via detention (for sediments, associated pollutants and hydrologic impacts) on top of the requirements which they will have through their Phase II NPDES permit. The Southwest Region did attempt to consult with the California Department of Transportation on Statewide Storm Water Management Plan published in August of 2001. However, the consultation was never completed.

The State Water Resources Control Board (SWRCB) is the agency in California which is responsible for executing Clean Water Act programs and activities delegated to the State by the Environmental Protection Agency. The SWRCB set up a structure of nine Regional Water Quality Control Boards to execute this task in addition to their duties defined under state laws.

An organizational structure for NPDES stormwater permitting has emerged in California in recent years and appears to be expanding to all nine regions in the state. The NPDES Phase I permits undergoing renewal currently incorporate a Standard Urban Stormwater Management Plan (SUSMP) that was approved by the SWRCB in 2000. The SUSMP structure defines development and redevelopment projects that are required to meet the numeric sizing criteria for treatment by BMPs. The numeric sizing criteria utilize either volume or flow-based BMPs. The same set of sizing criteria have appeared across California in Phase I permits since their adoption and are expected to appear in the Phase II permits (starting in 2003) as well. A consultation on these standards or associated BMPs for efficacy in protecting listed salmonids has not been initiated by the State or EPA.

The State is currently revising its California Storm Water Quality Task Force Best Management Practices Handbook. It is scheduled for publication in January 2003.

Idaho

[placeholder]

Appendix D
Glossary

Basin. Drains to a major receiving water such as large river, estuary or lake. Basin drainage areas typically exceed several thousand square miles (1,000 to 10,000 square miles). Using this terminology, five basic watershed management units are recognized that have unique physical characteristics and management focus (Center for Watershed Protection, 2002). The smallest unit is a catchment, then a subwatershed, watershed, subwatershed and basin. At the Basin scale, State, Multi-State, and Federal governments are the primary planning authorities, focusing on Basin Planning.

Catchment. The area that drains an individual development site to its first intersection with a stream, ranging from a few acres up to several hundred acres in size. BMP's and Site design are the management focus at this scale.

Effective impervious area (EIA). Those impervious surfaces with a direct hydraulic connection via sheet flow or discrete conveyance to the downstream drainage (or stream) system. Impervious surfaces on residential development sites are considered ineffective if the runoff is dispersed through at least one hundred feet of native vegetation prior to discharge. This parameter, at least conceptually, captures the hydrologic significance of imperviousness.

Impervious surface (IS). A hard surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. Impervious surfaces are mainly constructed surfaces - rooftops, sidewalks, roads, and parking lots - covered by impenetrable materials such as asphalt, concrete, brick, and stone. These materials seal surfaces, repel water and prevent precipitation and melt water from infiltrating into soils. Soils compacted by urban development are also highly impervious.

Lowland streams. Streams flowing through tablelands with moderate relief, plains with hills or mountains, or open hills. Generally third or fourth order streams or greater.

Stream order
A stream classification system (Strahler, 1957) characterizing streams by their "order". Headwater streams are designated first-order; two first-order streams combine to form a second-order stream. Two second-order streams combine to form a third-order, etc. First- and second-order streams may have small or intermittent flows during the dry season, with average gradient often exceeding 10%. Third- and fourth-order streams usually flow continuously with average gradient of less than 5%.

Subbasin. Defined by the lands draining to a large receiving water, usually a river or estuary, and extending 100 to 1,000 square miles. Local, regional and /or State planning authorities conduct Basin Planning at this management unit scale.

Subwatershed. An area that includes all the land draining to the point where two second order streams combine together to form a third order stream. In most regions a subwatershed is 1 to 10 square miles in area, and is drained by a creek or stream that is several feet wide. The management focus at this scale is stream classification and management carried out by local government.

Total impervious area (TIA). The total of all impervious surfaces in a specified area (subwatershed, watershed, etc.) generally based on assigning a regionally-accepted, specific percent imperviousness to the various categories of land-use within a basin, (Alley and Veenhuis, 1983) and multiplying the % TIA values by the surface area of each land use to obtain a final % TIA for each basin. Total impervious area includes all impervious surfaces, whether they drain to conveyance systems or not.

Transitional streams. Streams passing from being considered headwater streams (generally stream order one) to lowland streams (generally stream order three or greater).

Watershed. An area encompassing the lands that drain larger streams, and composed of several subwatersheds, typically spanning 10 to 100 square miles. The management focus at this scale is watershed-based planning by a local or multi-local government.

Appendix E
Acronyms

B-IBI	Benthic Index of Biological Integrity
BMPs	Best Management Practices
CFR	Code of Federal Regulations
CSO	Combined Sewer Overflow
CWA	Clean Water Act
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973 as amended through 1988
ESU	Evolutionarily Significant Unit
FC	Forest Cover
HCD	Habitat Conservation Division, a division of NOAA Fisheries (NMFS)
HCP	Habitat Conservation Plan
IS	Impervious Surface
LAA	Likely to Adversely Affect determination
LW	Large Wood
MPI	Matrix of Pathways and Indicators
MS4	Municipal Separate Storm Sewer System permits
NLAA	Not Likely to Adversely Affect determination
NMFS	National Marine Fisheries Service, an agency of the Federal government under NOAA/DOC, which is the lead agency for ESA issues regarding anadromous fish
NOAA	National Oceanic and Atmospheric Administration, an agency within the Department of Commerce which houses NMFS

NPDES	National Pollutant Discharge Elimination System permits
ODEQ	Oregon Department of Environmental Quality
OSB	Oregon State Branch of the NOAA Fisheries Habitat Division
PFC	Properly Functioning Condition
PSWQMP	Puget Sound Water Quality Management Plan
SPTH	Site Potential Tree Height
SUSMP	Standard Urban Stormwater Management Plan
SWRCB	State Water Resources Control Board (California)
TIA	Total Impervious Area
USFWS	United States Fish and Wildlife Service (in the Department of the Interior)
USGS	United States Geological Survey
WDOE	Washington Department of Ecology
WSDOT	Washington State Department of Transportation