SOUTHWEST IDAHO ECOGROUP MATRIX OF PATHWAYS AND WATERSHED CONDITION INDICATORS - "THE MATRIX"

Overview Of The Matrix

The revised Forest Plan management direction (goals, objectives, standards, and guidelines) found in Chapter III of this document replaces direction in the Forest's Land and Resource Management Plan, as amended by Pacfish/Infish, and the 1995 and 1998 Biological Opinions (BOs) for listed fish species. Appendix B was created and tied to direction in Chapter III of this Plan, and it incorporates components of Pacfish/Infish, the 1995 and 1998 Opinions, the Endangered Species Act (ESA), and the Clean Water Act (CWA) important to the Forests long-term Aquatic Conservation Strategy (ACS).

Specifically, Appendix B combines the separate matrices [NMFS (NOAA Fisheries), 8/96; FWS 2/98] identified for use in the 1995 and 1998 BOs. In order to combine the two original matrices, modifications were made to provide consistency and efficiency in application. Within Forest Plan documents, Appendix B may be referred to as Appendix B, the Southwest Idaho Ecogroup Matrix of Pathways and Watershed Condition Indicators, or the "Matrix". The Matrix is the second component of the ACS.

Information and process guidance provided in this Appendix comprise a decision support tool that has been developed to assist land managers in assessing how well management actions designed to implement the Forest Plan move toward related resource goals. Specifically, the Matrix and related Watershed Condition Indicators (WCIs) discussed in this appendix will assist in:

1. Identifying how management actions may potentially influence the condition and trend of soil, water, riparian, and aquatic resources, including native and desired non-native fish.

2. Making ESA Determinations of Effects to Listed Fish Species important to assessing ESA compliance.

3. Identifying how management actions may potentially influence beneficial uses associated with native and desired non-native fish habitat and the importance of that influence to assessing CWA compliance.

The Matrix has been designed for application during project-specific NEPA assessments to assist in project design and analysis. A hierarchal sequence is followed to ascertain which fish species and/or beneficial uses the Matrix is focused on, ensuring the most imperiled fish species or most limiting designated beneficial use is considered first. Project-level analyses are generally conducted at the watershed or subwatershed scale (5^{th} or 6^{th} field hydrologic units or HUs), which are the typical scales at which aquatic and water resource cumulative effects analyses are completed in a project NEPA analysis. Analyses may also be conducted at the subbasin scale (4^{th} field HU) depending on the geographic extent and scope of the proposed action(s), and the scale at which cumulative effects need to be addressed in any project-specific NEPA analysis. The ID team and the appropriate line officer (District Ranger or Forest Supervisor) for each project (i.e., management action) determine the analysis scale(s). Where the action may influence listed fish species directly, indirectly or cumulatively, the line officer should determine the appropriate scale of analysis in conference with the Level 1 streamlining team.

As stated above, Appendix B is referenced within specific Forest-wide objectives, standards, and guidelines related to Forest Plan goals found in two resource sections: (1) Threatened, Endangered, Proposed and Candidate (TEPC) Species, and (2) Soil, Water, Riparian and Aquatic (SWRA) Resources.

Additional objectives, standards, and guideline are included in specific Management Area direction, but are not referenced here.

The direction statements for TEPC Species and SWRA Resources directly or indirectly relate to multiple goals, objectives, standards and guidelines under many resource sections in Chapter III. For example, an action that proposes to revise an allotment management plan would need to comply with all applicable Forest-wide standards and guidelines in Chapter III. For instance, standards such as Rangeland Resources 1 ("Livestock trailing, driving, bedding, watering, and other handling efforts shall be limited to those acres and times that maintain or allow for restoration of beneficial uses and native and desired non-native fish habitat") and SWRA Resources 1 ("Management actions shall be designed in a manner that maintains or restores water quality to fully support beneficial uses and native and desired non-native fish species and their habitat") would need to be met before the action could proceed. To assist in determining whether this action will maintain or allow for restoration of beneficial uses and native and desired non-native fish habitat, and meet both standards, the land manager would use the Matrix at the appropriate scale in Appendix B.

Forest-wide Standards SWRA 1 and SWRA 4, along with other protections, are intended to improve aquatic and riparian functions and processes over the life of the Plan. The Matrix can be an important tool in tracking how management actions, over time, are trending "functioning at unacceptable risk" (FUR) and "functioning at risk" (FR) indicators toward a "functioning appropriately" (FA) condition, or are maintaining already FA indicators at multiple scales. How quickly WCIs obtain a FA condition depends on the baseline, the kinds of management actions that are implemented and their effects over time, and the types of natural disturbances that occur.

Not every project, even in a degraded baseline, will be restorative. Some management actions will be proposed in a watershed with a FUR baseline that will result in a temporary or possibly short-term "degrade" in the Matrix. These management actions are appropriate as long as they do not retard the attainment of riparian processes and functions, have measurable long-term ecological benefits, and do not have substantially measurable short-term effects to important subwatersheds or to the overall watershed (5^{th} field HU) scale. If riparian and watershed processes are to be restored over time within watersheds that have a FR or FUR baseline, it is critical that management actions individually and collectively do not further degrade or retard attainment of WCIs. It is also critical that management actions in ACS priority subwatersheds provide some degree of restoration to WCIs at the appropriate temporal and spatial scales if desired conditions are to be achieved. For example, if after ten years management actions in an ACS priority subwatershed have only maintained FUR or FR WCIs, then restoration would not be realized and the intent of the long-term ACS would not be realized.

The Matrix is designed to be applied over a range of analysis scales and account for a variety of environmental conditions. It provides flexibility and allowances for addressing localized information and/or project-specific variability. A certain degree of professional judgment is required and is an essential element for effectively interpreting and applying evaluation results.

It is expected that improvements to the Matrix will occur in the future and periodically result in refinement and updates to the WCI range of values and processes found in this appendix. Improvements may include, but are not limited to, changes to the parameters or indicator values within the various WCIs, additions or deletions of WCIs, or replacement of this Matrix with a different process that meets the same intent through more efficient and effective means.

Description Of The Matrix

Introduction

There are four components/tables in the Matrix (see Figure B-1). Tables B-1, B-2, and B-3 should be used when evaluating actions that would affect SWRA resources, regardless of whether listed fish species would also be affected. Table B-4 should only be used when ESA-listed fish species may be affected.

- Table B-1: Pathways for WCIs, "Reference Conditions"
- Table B-2: Environmental Baseline, "Current Conditions"
- Table B-3: Effects of Management Actions
- Table B-4: Dichotomous Key for Making ESA Determinations of Effect and Documentation of Expected Incidental Take for Listed Fish Species.

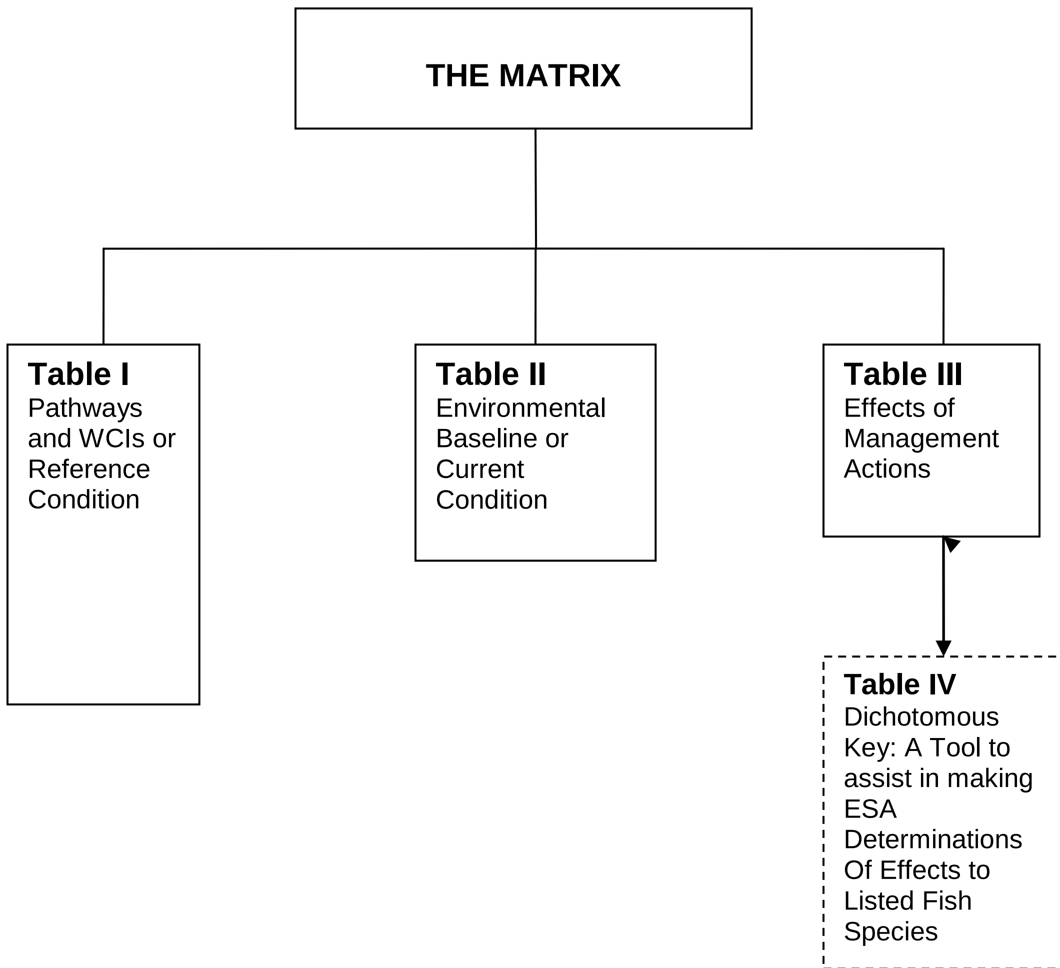
Tables B-1, B-2, and B-3 are divided into 8 overall pathways (major rows). Each of these rows represents a significant pathway by which actions can have potential effects on native and desired non-native fish species, their habitats, and associated beneficial uses. Pathways are further broken down into WCIs. WCIs are described in terms of functionality (Appropriate, At Risk, At Unacceptable Risk). The Functioning Appropriately column represents the desired condition to strive toward for each particular WCI. These WCIs improve upon and update the Riparian Management Objectives identified in Pacfish and Infish. The process outlined later in this Appendix will help land managers determine what the relevant WCIs are that should be considered where proposed management actions are expected to affect beneficial uses, and anadromous, inland native, or desired non-native fish or their habitat.

The evaluation of WCIs provides a consistent and logical line of reasoning to recognize when, where and why adverse, beneficial or no effects may occur to related resources. WCIs are not independent from other components of the aquatic conservation strategy but provide a starting point to describe the current and desired condition for upland watershed condition, water quality, and aquatic habitat. Evaluation procedures consider the suite of WCIs that are likely to be affected by proposed management actions, not just effects to any individual WCI. WCIs are not always sensitive to immediate effects and may instead exhibit response to cumulative effects within subwatersheds over time. In some cases, adverse effects to one WCI in the temporary or short term may be acceptable in order to improve another WCI in the short and/or long term. The duration of an adverse impact that may be allowed in the temporary or short term in order to improve another WCI and provide for long-term benefits will depend on site-specific conditions and resources of concern. Results from the evaluation of WCIs affected by a proposed action can be used to help modify the design of the actions, including mitigating adverse impacts, and developing strategies for restoration of degraded conditions.

The Dichotomous Key included as Table B-4 of this Matrix is used to assist in making ESA effects determinations where effects to listed fish species are likely to occur. It is important to note that use of Table B-4 of this Matrix will not, in itself, result in effects determinations for listed fish species from management actions. The purpose of the Key is to provide indicators as to what the effect is likely to be relative to results from evaluations in Tables B-1, B-2, and B-3. Information obtained from this Matrix should be used in biological assessments to support ESA determinations relative to the potential site-specific effects of the proposed activities evaluated.

Figure B-1. Southwest Idaho Ecogroup Matrix of Pathways and Watershed Condition Indicators

Pathways For Watershed Condition Indicators (WCIs), Environmental Baseline, Effects Of Management Actions, and Dichotomous Key: A Tool To Assist In Making ESA Determinations Of Effects To Listed Fish Species



Appropriate Matrix Scale

The Matrix can be used at several (multi) scales. Riparian functions and ecological processes represented by the Matrix operate at multiple scales, including site, subwatershed, watershed, and subbasin. Similarly, the effects of land management activities on these functions and processes can occur at multiple scales, depending on the scope and magnitude of the action, and the baseline, sensitivity, and watershed recovery trajectory of the affected resources. Assessment of management action effects should address the spatial and temporal scales that are relevant to the proposed action and to the WCIs that would be affected.

The project (i.e., management action) scale will generally be the smallest scale that the Matrix is used. Typically the project scale is equivalent to the 7th or 6th field HU. However, smaller scales (e.g., site) may be appropriate in some cases. If a site is determined to be the appropriate scale to assess, the user should be aware that some indicators (e.g., refugia, disturbance history, road density, etc.) may not be appropriate or relevant and should not be evaluated. If little information is available at the site scale, it may be acceptable to use, and note appropriately, information collected at the 7th or 6th field HU scale as a surrogate for the baseline condition portion of the Matrix. Impacts of the action should be assessed at the actual site scale. Ultimately, the ID team and appropriate line officer for each project should determine the analysis scale(s). Where the action may influence listed fish species directly, indirectly or cumulatively, the line officer should determine the appropriate scale of analysis in conference with the Level 1 streamlining team.

The Matrix may often be prepared at two or more spatial and temporal scales. When an indicator is likely to be degraded (temporary, short term or long term) by the impacts of an action or actions, a second Matrix at the next larger scale should be prepared to evaluate the impacts of the actions to the larger WCIs. Typically this analysis would be completed at the watershed (5th field HU) scale. The larger-scale matrix may also be relevant when assessing the aggregate effects of several actions with "degrade" checkmarks within a watershed during batched and programmatic consultations. Not all indicators or their values may be appropriate at a 4th field scale. For example, pool frequency is a good indicator at the project or subwatershed scale. But at the subbasin scale it may be more appropriate to stratify pool frequency by geomorphic landtypes, or aggregate the total number by local populations to look for landscape patterns. Completion of a 4th field HU (subbasin) Matrix will be uncommon, but, when needed, the user should work with either the Level 1 team or the Continuous Assessment Planning Team (CAP) to develop appropriate indicators and values.

Table B-1: Pathways and WCIs "Reference Conditions"

Table B-1 of the Matrix is similar to "Step 4: Description of Reference Conditions" section for soil, water, riparian and aquatic resources described in *Version 2.2 of the Federal Guide for Ecosystem Analysis at the Watershed Scale* (Regional Interagency Executive Committee 1995). The eight pathways described in this table represent a suite of ecological indicators identified as WCIs. The reference condition values of ecological indicators, or WCIs, found in Table B-1 are diagnostic tools to assist in comparing and evaluating current SWRA watershed conditions to be described in Table B-1I. The WCI values provided in Table B-1 were largely taken from the original matrices tied to the 1998 BOs for steelhead and bull trout. These values are considered the default values that should be used, unless better subwatershed or project-specific information is available to update these values (refer to the "How to Modify this Matrix" section in this appendix).

The WCIs are generally arranged from a finer to a broader scale. For example, under the pathway "Habitat Elements," the WCIs refer to information from the channel unit level (substrate); to the stream reach level (large woody debris, pool frequency and quality/large pools), to the valley segment (off-channel habitat), and finally the complete watershed (refugia). Definitions for the WCIs are found at the end of this appendix.

Units of measure specific to each WCI are provided, followed by functionality definitions for each WCI that are represented as ranges within their respective units of measurement. There are three functional condition levels identified for each WCI: (1) "functioning appropriately, or FA," (2) "functioning at risk, or FR," and (3) "functioning at unacceptable risk, or FUR."

The quantitative and qualitative default WCI values provided are not intended to be absolute values that precisely define desired conditions or to define data standards. The values and descriptions are a diagnostic tool to promote discussions and evaluations of the environmental functional relationships specific to the watershed being considered for management actions. WCIs are criteria to assist in evaluating progress towards an attainment of SWRA goals. They do not replace state and federal water quality standards under the Clean Water Act or state laws, nor do they make determination of effects for proposed management actions under ESA. However, WCIs do address several important objectives of the Clean Water Act by determining whether designated beneficial uses are attainable and to what degree these uses are supported (Bauer and Ralph 1999). WCIs complement existing laws and standards by providing measurable criteria for water quality and aquatic habitat.

If local data relating to a specific WCI are not available for comparison and verification, then proposed management actions should be designed to minimize adverse impacts to the WCI based on the default value provided in Table B-1. If local data are available to help define a more site- or watershed-specific WCI value, follow procedures in *the "How to Modify the Matrix"* section to document the basis for the change. Likewise, if a default WCI value is not functionally attainable given the inherent characteristics of the watershed being considered, follow procedures outlined in *the "How to Modify the Matrix"* section to document the basis for varying from the default WCI value provided.

Table B-2: Environmental Baseline "Current Conditions"

Table B-2 of the Matrix is similar to "Step 3: Description of Current Conditions" section for soil, water, riparian and aquatic resources described in *Version 2.2 of the Federal Guide for Ecosystem Analysis at the Watershed Scale* (Regional Interagency Executive Committee 1995). Completion of Table B-2 also provides the supporting documentation and rationale for the evaluations and determinations of the environmental baseline condition included in a watershed or project- specific NEPA analysis. The environmental baseline, or current condition, can be assessed at multiple spatial scales; typically at the project scale representing a 7^{th} or 6^{th} field HU. The baseline can be recorded at larger scales (e.g., 5^{th} or 4^{th} field HUs) to address cumulative effects of a proposed management action or actions. When evaluating the baseline condition, all landownerships should be included at the relevant spatial scale for which the Matrix is completed.

The current condition of each WCI is represented as falling within its respective functionality class as described in Table I, including any refinements to the default values for that class. Thus, this evaluation documents whether a WCI is "functioning appropriately", "functioning at risk" or "functioning at unacceptable risk". The units of measure for WCIs are generally reported in one of two ways: (1) quantitative metrics that have associated numeric values (for example, "large woody debris: > 20 pieces per mile"); or (2) qualitative descriptions based on field reviews, professional judgment, etc., (e.g., "physical barriers: man-made barriers present"). Different approaches are needed because numeric data are not always readily available for every WCI, or there are no reliable numeric values. In such cases, a qualitative description of overall functionality may be the only appropriate method to describe the value. Ideally, the baseline condition determination is based on site measurements, but if data are not available another form of measurement and/or professional judgment must be applied. It is not anticipated that new field surveys would be required for every project. The level of information collected should be commensurate with the scope and scale of project being proposed. Those projects that have a greater chance of causing negative effects in subwatersheds with no to little baseline information should conduct the appropriate level of field surveys to support the decision.

When documenting the baseline condition in the Matrix the rationale for that condition must be supported with a quantitative and/or narrative description. Biologists are encouraged to reference this rationale by citing existing documentation, such as NEPA analyses, whenever possible. When professional judgment is required to document the existing condition, a "PJ" for professional judgment should be included next to the indicator in the baseline column in Table B-2. For example, if pool frequency is believed to be "functioning at risk", a FR – PJ should be noted. Other data sources should also be noted according to the following criteria: WA - Watershed Analysis; NEPA – CE, EA or EIS; SR – Surveys; M – Monitoring; FR – Field Reviews; O – Other.

The suite of relevant WCIs, considered together, encompasses the environmental baseline or current condition for the subwatershed and associated aquatic resources. The user must realize not every indicator may be relevant to every area assessed. For example, indicators specific only to bull trout (e.g., life history, genetic characteristics, etc.) would not be completed if bull trout were currently or historically absent in the assessment area. In these situations a "not applicable" should be recorded under the desired and existing condition columns.

In most cases, the "Functioning Appropriately" values in Table B-1 will be displayed in the desired condition column in Table B-2. However, as described in the "*How to Modify the Matrix*" section, WCIs can be refined to better reflect conditions that are functionally attainable in a specific subwatershed or stream reach based on local geology, land and channel form, climate, and potential vegetation. If WCI values are modified, then the referenced value or its range should be included in the desired condition column with a footnote listing what process was used.

Table B-3: Effects of Management Actions

Table B-3 of the Matrix is the assessment of potential impacts of the action. The Matrix provides a synthesis of the collective effects of a proposed or ongoing action(s) on WCIs. This information and evaluation will assist the land manager in determining if native and desired non-native fish habitat important to fish populations will be sustained, and if water and aquatic resource beneficial uses identified by the State will continue to be supported.

The effects of management actions described in Table B-3 are represented as a change in the functionality of the WCI(s) that would likely result from proposed or ongoing management actions. Effects are identified on the basis of the amount of restoration or degradation for each WCI. Table B-3: Effects of Management Actions is designed to be used in conjunction with both Table I: Pathways and WCIs, and Table II: Environmental Baseline. Together they document the effects on a WCI in terms of being "restored", "maintained", "degraded", or "not applicable". A positive, negative, or "no" trend is then noted for three time periods (temporary, short term, and long term) for that particular WCI. A brief narrative or reference to an existing NEPA document is included in the Matrix. As with baseline conditions, each action impact in the Matrix must be supported with a quantitative and/or narrative description. Users must remember that the Matrix is merely a tool to summarize the NEPA analysis. A thorough description of how an action affects WCIs, at different spatial and temporal scales, in NEPA analysis is critical. All terms are defined in the Glossary of this appendix.

The suite of WCIs must be considered together, both those affected by a proposal and those not affected, in order to fully describe the condition and trend of the subwatershed and associated aquatic resources and designated beneficial uses that would result from implementation of a proposed management action or continuation of ongoing actions. Completion of Table B-3 provides supporting documentation and rationale for the evaluations and determinations of effects included in biological assessments and/or project-specific NEPA analyses. When Table B-3 is completed to support findings in a biological assessment or project-specific NEPA analysis, it should be appropriately referenced within the body of the document.

In some cases it may be appropriate to note both short-term impacts and long-term benefits in the Matrix at the project or subwatershed scales. When this is needed, a "degrade" and "restore" would be recorded in the Effects column, and the appropriate temporal scale would be indicated.

Table B-4: Description of Dichotomous Key for Making ESA Determinations of Effect and Documentation of Expected Incidental Take for Listed Fish Species

The Dichotomous Key for Making Determinations of Effect is the fourth component of the Matrix. It is specifically designed to aid in the determination of effects relative to proposed management actions that **require** a Section 7 consultation or conference, or a permit under Section 10 of the ESA. Evaluations that use the Dichotomous Key draw from information generated in Tables B-1, B-2, and B-3, including any modifications to WCIs completed through procedures that incorporate better subwatershed or site-specific data that are available. The findings from evaluations using the Dichotmous Key are used to help make related ESA determinations of effect.

Table B-4 was not designed to be used to aid in the determination of effects for proposed management actions that **do not require** a Section 7 consultation or conference of the ESA.

How And When To Use The Matrix

The Matrix has been developed to help design, and estimate the effects of, management actions to WCIs used as indicators of soil, hydrologic, water quality, riparian and aquatic resource conditions within the subwatershed, as well as to ESA-listed fish species where applicable. A Matrix can be completed for one action or a set of actions specific to a particular spatial and temporal scale. To determine when the Matrix should be used and which tables should be completed, use the following criteria:

1. Management actions will have no effect on listed species and WCIs will be maintained.

2. Management actions **WILL** result in quantifiably measurable, or clearly defined qualitative, negative effects (temporary, short term, or long term) on WCIs, and the proposed management action **does not require** a Section 7 consultation or conference of the ESA. **COMPLETE MATRIX TABLES B-1, B-2, and B-3 only.**

3. Management actions **WILL** result in small effects, beneficial effects, or quantifiably measurable, or clearly defined qualitative, negative effects (temporary, short term, or long term) on WCIs and the proposed management actions **require** a Section 7 consultation or conference of the ESA. **COMPLETE ALL MATRIX TABLES.**

If it is determined that all or some of the tables in the Matrix should be completed, use the following criteria to determine which aquatic species or water quality beneficial use evaluations the Matrix user should focus on:

1. If the watershed has ESA-listed fish species, sensitive fish species, and non-listed fish species, the Matrix for the ESA-listed species should be completed.

2. If the watershed has sensitive fish species and non-listed fish species, but no ESA-listed species, use the Matrix for sensitive species, with modified parameters (or criteria) for the WCIs appropriate for those species.

3. If there are only non-listed and non-sensitive fish species in the watershed, use the Matrix for native, or desired non-native fish species, with modified parameters (or criteria) for the WCIs appropriate for those species and associated beneficial uses.

4. If there is a TMDL or 303(d) listed water quality limited water body, and the management action may have impacts on the WCI value(s) for which it was listed, and only non-listed and non-sensitive aquatic species are present, use the Matrix for native or desired non-native fish species, with modified parameters (or criteria) for the WCIs appropriate for those species and associated beneficial uses.

Table B-2 linkage to Table B-1

For each project area, determine the environmental baseline by describing the conditions for the WCIs listed under the pathways that may be affected by the management action against the reference condition for the WCI described in Table I. This will result in each WCI in Table II being classified as either: "Functioning Appropriately" (FA), "Functioning at Risk" (FR), or "Functioning at Unacceptable Risk" (FUR). It is preferred that the WCI values used to determine FA, FR and FUR be based on local data collected over time that either validates the default value or refines the value to better reflect local conditions following procedures in described in the "*How to Modify the Matrix*" section, below. If local data are lacking, consider the biophysical characteristics of the subwatershed when determining functionality categories, and use local databases and/or related literature to discern the most appropriate WCI values for the Matrix.

Table B-3 linkage to Table B-2

Use Table B-3 to evaluate the expected effects of management actions (or groups of actions) on the WCIs by comparing the expected effects on the WCIs against the environmental baseline in Table B-2. Where conditions are FR or FUR, actions that affect WCIs that are not fully functioning will not retard attainment of WCIs unless to meet the exceptions in SWRA Standard 4. For example, management actions that have temporary or short-term effects can still be consistent with Forest-wide TEPC and SWRA objectives, standards, and guidelines if they do not retard the attainment of riparian processes and functions, have significant long-term benefits, and do not have significant short-term effects to important subwatersheds or to the overall watershed scale. Actions that have long-term impacts to important subwatershed and/or watershed-scale processes would likely prevent the attainment of WCIs and be inconsistent with Forest Plan direction. Where conditions are FA, the action(s) should be designed to maintain those conditions in the short and long term.

It is important to understand that all effects are not the same just because they may occur within the same temporary, short-term, or long-term time period. The duration or repetition of an effect within that time period can vary greatly, as can the intensity, location, or type of effect. The Matrix allows Forest personnel the flexibility to determine these differences during project-level analysis and provides a means to display if the temporary, short-term, or long-term effect has a positive, negative, or no trend. If WCIs within a pathway are not evaluated in Table B-2 or B-3, documentation describing why they were not evaluated should be included in the project record.

Table B-4 linkage to Tables B-2 and B-3

Use evaluations in Tables B-2 and B-3 to answer the questions in the dichotomous key contained in Table B-4. Written documentation of rationale and logic substantiating answers to questions generated through interdisciplinary and Section 7 consultation or conference discussions should be included in the project record and used to support determinations reached in biological assessments and NEPA documents.

Examples Describing the Use of the Matrix

The following are some brief examples to assist in describing the intended use of the Matrix.

Example 1 - Thinning and prescribed fire are proposed as vegetation treatments over a large portion of a 6^{th} field HU. Current large woody debris (LWD) frequency is 10 pieces per mile, below the FA value of >20. Assuming the values for a FA call are appropriate for the geoclimatic setting, the proposed activity should be designed in such a way that desired conditions would be reached and lead to attainment of Functioning Appropriately conditions over the long term. At the stream reach level, site-specific project design features to promote FA conditions might include increased RCA widths, adjustment of the treatment unit boundaries, or changes in how the specific treatment tool (prescribed fire ignitions or mechanical thinning) is implemented.

Example 2 - The action is to replace a damaged culvert in a 6th field HU with a FR baseline. Currently, surface fines are between 12 and 20 percent, and embeddedness is between 20 and 30 percent. This action will cause temporary degradation to turbidity and embeddedness indicators downstream, but impacts will not go beyond the 6th field HU. The action will also restore the fish passage indicator, and will maintain all remaining indicators. This action will be appropriate because it does not retard the attainment of riparian processes and functions, has measurable long-term ecological benefits by providing fish passage, and does not have substantially measurable short-term effects.

Example 3 - Existing fine sediment levels in bull trout spawning gravels ($\leq$ 6.0 mm) are approaching the desired condition of $\leq$ 12 percent, and the local bull trout population is small and isolated. A temporary increase in sediment from one individual project could yield signficant adverse effects to bull trout that could be significant in both short- and long-term effects on the isolated local population. Also, temporary inputs of sediment could have short- and long-term consequences if channel morphology and stream gradient are associated with infrequent flushing. Low-gradient stream channels might retain sediment for decades.

The question to be answered is whether or not temporary effects from any proposed action will sustain the local isolated population of bull trout and associated beneficial uses. For instance, proposed restoration activities may be appropriate for short-term or long-term recovery, but the timing may not be right if existing stream habitat conditions would be degraded. If the isolated bull trout population would be at risk from temporary effects, it may be prudent to delay project implementation until stream conditions improve, or implement management actions incrementally, using more restrictive BMPs. The over-riding objective is to avoid or minimize temporary jeopardy risks to the bull trout population while striving to recover the habitat that will allow for increasing the bull trout population in the short and long term.

Example 4 - A new placer mine, timber sale, and road restoration project are planned over several 6th field HUs in the same 5th field watershed. The placer mine occurs in a 6th field HU where most indicators are FA. The timber sale and road projects occur in HUs where many baseline indicators are FUR or FR. Even though the placer mine will have short- and long-term adverse effects to pool quality and streambank indicators, it is allowed to proceed due to the 1872 mining law. The other two projects are designed to restore WCIs in the long term, but will cause degradation in the temporary and short term to sediment and peak flows at the 6th field scale.

Cumulative effects from these actions are expected to occur in a low-gradient reach downstream of each project. A second Matrix is prepared to see if cumulative effects will degrade WCIs at the watershed scale and over what timeframe. If cumulative effects are determined not to degrade or retard indicator functions, the actions can proceed. If cumulative effects degrade indicators at the subwatershed scale, then projects are modified to reduce effects or delayed until baseline conditions improve to be consistent with the Forest Plan.

How To Modify The Matrix

When a WCI value identified in the Matrix is not physically or biologically appropriate, given the inherent characteristics (geoclimatic setting) of the subwatershed, the WCI should be modified. WCIs should be refined to better reflect conditions that are functionally attainable in a specific watershed or stream reach based on local geology, land and channel form, climate, historic and potentially recoverable fish species habitat, and potential vegetation. Modification of interim default WCIs may be completed through a variety of methods such as mid-level analysis, Forest-wide monitoring results, and collection and evaluation of watershed and/or stream reach specific data.

Ideally, when modifying WCIs, suitable reference conditions should be used to adopt more functionally attainable indicator values. Reference conditions should be as representative as possible of historical values prior to significant management disturbance. However, since pristine subwatersheds are uncommon, there will need to be agreement on what constitutes an acceptable site to determine suitable reference conditions. Reference conditions may be established using a combination of methods including surveys, historical data, and inferences made from literature, professional judgment, and local landscape conditions. Regardless of what methods are used, written documentation of the methods and procedures, quality and source of data, and rationale supporting the modifications should be included in record documentation for the project or mid-level analysis. In watersheds with ESA-listed fish species, modification of WCIs will be coordinated with NMFS and/or USFWS through Section 7 consultations.

The Matrix Tables

(Note: Parameters were taken from the 8/96 NMFS and 2/98 FWS Matrices)

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Bull Trout Local Population Characteristics within Core Areas			
Local Population Size	Mean total local population size or local habitat capacity more than several thousand individuals. Adults in local population > 500. All life stages are represented within the local population.	Adults in local populations < 500 but > 50.[1]	Adults in local population < 50.
Growth and Survival	Local population has the resilience to recover from temporary or short-term disturbances (e.g., catastrophic events, etc.) or local population declines within 1 to 2 generations (5-10 years). The local population is characterized as increasing or stable. At least 10 years of data support this estimate.[2]	When disturbed, the local population will not recover to pre-disturbance conditions within 1 generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The local population is reduced in size, but the reduction does not represent a long-term trend. At least 10 years of data support this characterization. If less data are available and a trend cannot be confirmed, a local population will be considered at risk until enough data is available to accurately determine its trend.	The local population is characterized as in rapid decline or is maintaining at alarmingly low numbers. Under current management, the local population condition will not improve with 2 generations. This is supported by a minimum of 5 years of data.
Life History Diversity and Isolation	The migratory form is present and the local populations are in close proximity to each other. Migratory corridors and rearing habitat (lake or larger river) are in good to excellent condition for the species. Neighboring local populations are large with high likelihood of producing surplus individuals or straying adults that will mix with other local populations.	The migratory form is present but the local population is isolated or fragmented.	The migratory form is absent and the local population is isolated to the local stream or a small watershed not likely to support more than 2,000 fish.

[1] Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. U.S.D.A. Forest Service, Intermountain Research Station, Boise ID.

[2] Rieman, B.E. and D.L. Meyers. 1997. Use of redd counts to detect trends in bull trout (*Salvelinus confluentus*) populations. Conservation Biology 11(4): 1015-1018.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Bull Trout Local Population Characteristics within Core Areas (continued)			
Persistence and Genetic Integrity	Connectivity is high among multiple (5 or more) local populations with at least several thousand fish each. Each of the relevant local populations has a low risk of extinction. The probability of hybridization or displacement by competitive species is low to nonexistent.	Connectivity among multiple local populations does occur, but habitats are more fragmented. Only 1 or 2 local populations represent most of the fish production. The probability of hybridization or displacement by competitive species is imminent, although few documented cases have occurred.	Little or no connectivity remains for re-founding local populations in low numbers, in decline, or nearing extinction. Only a single local population, or several local populations that are very small or that otherwise are at high risk remain. Competitive species readily displace bull trout. The probability of hybridization is high and documented cases have occurred.
Water Quality			
Temperature (steelhead, chinook)	7-day average maximum. Spawning, rearing and migration: 50-57°F (10-13.9°C)[3]	Spawning: 57-60 °F (13.9-15.5°C) Migration and rearing: 57-64°F (13.9-17.7°C)[4]	Spawning: >60 °F (>15.5°C) Migration and rearing: >64°F (>17.7°C)
Temperature (bull trout)	7-day average maximum temperature in a reach during the following life history stages:[5] Incubation: 2-5°C or 35.6-41.0°F Rearing: 4-12°C or 39.2-53.6°F Spawning: 4-9°C or 39.2-48.2°F Also temperatures do not exceed 15°C or 59.0°F in areas used by adults during migration (no thermal barriers)	7-day average maximum temperature in a reach during the following life history stages:[5] Incubation: <2°C or 6°C or <35.6°or 42.8°F. Rearing: <4°C or 13-15°C or <39.2°F or 55.4-59.0°F Spawning: <4°C or 10°C or 39.2°F or 50.0°F. Also temperatures in areas used by adults during migration sometimes exceed 15°C or 59.0°F.	7-day average maximum temperature in a reach during the following life history stages:[5] Incubation: <1°C or >6°C or <33.8°F or > 42.8°F. Rearing: >15°C or > 59.0°F Spawning: <4°C or >10°C 39.2°For > 50.0°F Also temperatures in areas used by adults during migration regularly exceed 15°C or 59.0°F (thermal barriers present)

[3] Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. American Fisheries Society Special Publication 19.83-138. Meehan, W.R., ed.

[4] Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995.

[5] Buchanan, D.V. and S.V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other coldwater species in Oregon, W.C. Mackay, M.K. Brewen, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings, held in Calgary, Alberta, May 5-7, 1994

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Water Quality (continued)			
Temperature (other fish species: i.e., redband, rainbow, wood river sculpin, etc.)	Use 7-day average maximum temperature. Species-specific criteria should be developed.		
Sediment/Turbidity (steelhead, chinook)	Low turbidity is indicated by < 12% surface fines (< 0.85 mm)[6]	Moderate turbidity is indicated by 12-20% surface fines (< 0.85 mm)[4]	High turbidity is indicated by > 20% surface fines (< 0.85 mm)[4]
Sediment/Turbidity (in areas of spawning and incubation; rearing areas will be addressed under substrate) (bull trout)	< 12% fines (< 0.85 mm) in gravel.[6] Surface fines (≤6mm) ≤ 12%[7, 8]	12-17% fines (<0.85mm) in gravel.[6] Surface fines (≤ 6mm) are 12-20%.	>17% fines (< 0.85mm) in gravel;[6] Surface fines (< 6mm) or depth fines (< 6mm) in > 20% in spawning habitat
Sediment/Turbidity (other fish species: i.e., red band, rainbow, wood river sculpin, etc)	Species-specific criteria should be developed.		
Chemical Contamination/Nutrients	Low levels of chemical contamination from agricultural, industrial, and other sources; no excess nutrients, no 303(d) water quality limited water bodies.[9]	Moderate levels of chemical contamination from agricultural, industrial, and other sources; some excess nutrients, one 303(d) water quality limited water body.[9]	High levels of chemical contamination from agricultural, industrial, and other sources; high excess nutrients, >1 303(d) water quality limited water bodies.[9]

[6] Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.

[7] Overton, C.K., J.D. McIntyre, R. Armstrong, S.L. Whitewell, and K.A. Duncan. 1995. User's guide to fish habitat: descriptions that represent natural conditions in the Salmon River Basin, Idaho. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-322.

[8] Overton, C.K., S.P. Wollrab, B.C. Roberts, and M.A. Radko. 1997. R1/R4 (Northern/Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-346.

[9] A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2). 1994.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Habitat Access			
Physical Barriers (address subsurface flows impeding fish passage under the pathway "Flow/Hydrology)	Any man-made barriers present in watershed allow upstream and downstream fish passage at all flows.	Any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows.	Any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows.
Substrate Embeddedness (Bull trout rearing areas. Spawning and incubation areas are addressed under the Sediment/Turbidity WCI)	Dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness is < 20%.[6], [10], [11],	Gravel and cobble is subdominant, or if dominant, embeddedness is 20-30%[6], [10]	Bedrock, sand, silt, or small gravel dominant, or if gravel and cobble dominant, embeddedness is > 30%[4], [10]
Large Woody Debris (Consider variations based on local biophysical elements, i.e., vegetation habitat type/community type, ecological processes, stream channel width and type, landform, etc., appropriate to the site.)	> 20 pieces per mile, > 12 inches in diameter, > 35 feet length;[4],[12] and adequate sources of large woody debris for both long and short-term recruitment in RCAs.	Currently meets standards for functioning appropriately, but lacks potential sources of short or long-term large woody debris recruitment from RCAs to maintain that desired condition.	Does not meet standards for functioning appropriately and lacks potential large woody debris for short and/or long-term recruitment.

[10] Biological Opinion on Implementation of Interim Strategies for Managing Anadromous fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). National Marine Fisheries Service. Northwest Region, January 23, 1995.
[11] Shepard, B.B., K.L. Pratt, and P.J. Graham. 1984. Life histories of westslope cutthroat and bull trout in the Upper Flathead River Basin, MT. Environmental Protection agency Rep. Contract No. R008224-01-5.
[12] Interior Columbia Basin Ecosystem Management Project Draft Environmental Impact Statement and Appendices.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Habitat Access (continued)			
Pool Frequency and Quality: consider variations based on local biophysical elements i.e., vegetation habitat type/community type, ecological processes, stream channel width and type, landform etc., appropriate to the site.	Pools have good cover and cool water, and only minor reduction of pool volume by fine sediment. Large woody debris recruitment standards for functioning appropriately (above) are met and pool frequency in a reach closely approximates:[7], [13] **Steelhead and chinook**: Channel <u>Width (ft.)</u> <u>No. Pools/Mile</u> 0-5 184 5-10 96 10-15 70 15-20 56 20-25 47 25-50 26 50-75 23 75-100 18 **Bull Trout**: Wetted <u>Width (ft.)</u> <u>No. Pools/Mile</u> 0-5 39 5-10 60 0-15 48 15-20 39 20-30 23 30-35 18 35-40 10 40-65 9 65-100 4 Can use the formula: pools/mile = <u>5280/wetted channel width</u> = # pools/mi # channel widths per pool	Pool frequency is similar to values in "functioning appropriately", but pools have inadequate cover/temperature,[6] and/or there has been a moderate reduction of pool volume by fine sediment. Large woody debris recruitment is inadequate to maintain pools over time.	Pool frequency is considerably lower than values desired for "functioning appropriately"; also cover/temperature is inadequate,[6] and there has been a major reduction of pool volume by fine sediment.

[13] USDA Forest Service. 1994. Section 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Basin.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Habitat Access (continued)			
Large Pools/Pool Quality (All Fish Species) In adult holding, juvenile rearing, and over wintering reaches where streams are 3.0 meters in wetted width at base flow.	Each reach has many large pools > 3.28 feet (1 meter deep).[6] Pools have good cover and cool water, and only minor reduction of pool volume by fine sediment.	Reaches have few large pools > 3.28 feet (>1 meter) present[6] or inadequate cover/temperature. Moderate reduction of pool volume by fine sediment.	Reaches have no deep pools > 3.28 feet (> 1 meter)[6] and inadequate cover/temperature. There is a major reduction of pool volume by fine sediment.
Off-channel Habitat (Appropriate to the watershed and associated stream system; is the stream capable of using its floodplain similar to an unmanaged stream system?)	Watershed has many ponds, oxbows, backwaters, and other off-channel areas with cover; side channels are low energy areas.[6]	Watershed has some ponds, oxbows, backwaters, and other off-channel areas with cover; but side channels are generally high-energy areas.[6]	Watershed has few or no ponds, oxbows, backwaters, or other off-channel areas.[6]
Refugia (steelhead, chinook) (see glossary for definition of steelhead and chinook refugia)	Habitat refugia exist and are adequately buffered (e.g., by intact riparian conservation areas); existing refugia are sufficient in size, number, and connectivity to maintain viable populations or sub-populations.[14]	Habitat refugia exist but are not adequately buffered (e.g., by intact riparian conservation areas); existing refugia are insufficient in size, number, and connectivity to maintain viable populations or sub-populations.[14]	Adequate habitat refugia do not exist.[14]
Refugia (bull trout) (see glossary for definition of bull trout refugia)	Habitats capable of supporting strong and significant local populations are protected and are well distributed and connected for all life stages and forms of the species.[14], [15]	Habitats capable of supporting strong and significant local populations are insufficient in size, number, and connectivity to maintain all life stages and forms of the species.[14], [15]	Adequate habitat refugia do not exist.[14]

[14] Frissell, C.A., W.J. Liss, and David Bayles. 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on Changing Roles in water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), p. 449-456.

[15] Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams and others. 1997. Chapter 4: Broadscale Assessment of aquatic Species and Habitats. In T.M. Quigley and S.J. Arbelbide eds “An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III.” U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen Tech. Rep PNW-GTR-405.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Channel Conditions and Dynamics			
Average Wetted Width/Maximum Depth Ratio in scour pools in a stream reach. (Consider variation in ranges based on stream channel type).	≤10 [4], [7], [10]	11-20 [7]	>20 [7]
Streambank Condition (Consider variation in ranges based on stream channel type).	>90% of any stream reach has stable banks[4],[7] relative to the percent of inherent stable streambanks associated with a similar unmanaged stream system.	80-90% of any stream reach has stable banks relative to the percent of inherent stable streambanks associated with a similar unmanaged stream system.	<80% of any stream reach has stable banks relative to the percent of inherent stable streambanks associated with a similar unmanaged stream system.
Floodplain Connectivity (Consider local landform, stream channel type, climatology, vegetation, etc.)	Within RCAs, floodplains and wetlands are hydrologically linked to the main channel; overbank flows occur and maintain wetland/floodplain functions; and riparian vegetation succession.	Within RCAs, reduced linkage of wetlands and floodplains to the main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland/floodplain function and riparian vegetation succession.	Within RCAs, severe reduction in linkage of wetlands, floodplains and riparian areas to the main channel; overbank flows are drastically reduced relative to historic frequency, as evidenced by substantial reduction of wetland/floodplain function and riparian vegetation succession.
Flow/Hydrology			
Change in Peak/Base Flows	Watershed hydrograph indicates peak flow, base flow, and flow timing characteristics comparable to an undisturbed watershed of a similar size, geomorphology and climatology.	Some evidence of altered peak flow, base flow, and/or flow timing relative to an undisturbed watershed of similar size, geomorphology and climatology.	Pronounced changes in peak flow, base flow, and/or flow timing relative to an undisturbed watershed of similar size, geomorphology and climatology.
Change in Drainage Network	Zero or minimum change in active channel length correlated with human caused disturbance.	Low to moderate change in active channel length correlated with human caused disturbance.	Greater than moderate change in active channel length correlated with human caused disturbance.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Watershed Conditions			
Road Density/Location[16]	Total road density < 0.7 miles/square mile of subwatershed,[16] no roads within RCAs.	Total road density 0.7-1.7 miles/square mile of subwatershed,[16] few roads within RCAs.	> 1.7 miles/square mile of subwatershed,[16] many roads within RCAs.
Disturbance History	< 15% ECA (entire watershed) with no concentration of disturbance in areas with landslide or landslide prone areas, and/or refugia, and/or RCAs.	< 15% ECA (entire watershed) but disturbance concentrated in landslide or landslide prone areas, and/or refugia, and/or RCAs.	> 15% ECA (entire watershed) and disturbance concentrated in landslide or landslide prone areas, and/or refugia, and/or RCAs.
Riparian Conservation Areas	The riparian conservation areas within the subwatershed(s) have historic and occupied refugia for listed, sensitive or native/desired nonnative fish species which are present and provide: adequate shade, large woody debris recruitment, sediment buffering, connectivity, and habitat protection and connectivity to adequately minimize adverse effects from land management activities (>80% intact). All vegetative components are within desired conditions identified in Appendix A of the Forest Plan. RCA functions and processes are intact, providing resiliency from adverse affects associated with land management activities. Conditions fully support habitat for aquatic species.	The riparian conservation areas within the subwatershed(s) contain known historic refugia for listed, sensitive, or native/desired nonnative fish species that are currently absent (but could be re-colonized). Land management activities have resulted in moderate loss to shade, large woody debris recruitment, sediment buffering, connectivity, and habitat protection. (Refugia < 70-80% intact.) Some vegetative components are outside desired conditions in Appendix A of the Forest Plan. RCA functions and processes are still generally intact, providing some resiliency from adverse affects associated with land management activities. Conditions generally support habitat for aquatic species.	Riparian conservation areas as a result of land management have resulted in loss of or substantially fragmented historic refugia, and provide inadequate protection of habitats for listed, sensitive, native or desired non-native fish species (< 70% intact). Historical refugia are currently absent of listed, sensitive, or native/desired non-native fish species. Most vegetative components are outside desired conditions in Appendix A of the Forest Plan. RCA functions and processes are not sufficiently intact, to mitigate adverse affects from land management activities. Conditions may not support habitat for aquatic species

[16] ICBEMP Science Assessment, Supplemental Roads Analysis

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Watershed Conditions (continued)			
Disturbance Regime	Disturbance resulting from land management activities are negligible or temporary. Streamflow regimes are appropriate to the local geomorphology, potential vegetation and climatology resulting in appropriate high quality habitat and watershed complexity that provide refugia and rearing space for all life stages or multiple life-history forms. Ecological processes are within historical ranges. Resiliency of habitat to recover from land management disturbances is high.	As a result of land management activities, scour events, debris torrents, or catastrophic fire are localized events that occur in several minor parts of the watershed. Ecological processes are moderately outside of historical ranges. Resiliency of habitat to recover from land management disturbances is moderate.	Frequent flood or drought producing highly variable and unpredictable flows, scour events, debris torrents, or high probability of catastrophic fire exists throughout a major part of the watershed. The channel is simplified, providing little hydraulic complexity in the form of pools or side channels. Ecological processes are substantially outside of historical ranges. Resiliency of habitat to recover from land management disturbances is low.
Integration of Pathways (steelhead, chinook)			
	Habitat quality and connectivity among subpopulations is high. Disturbance has not altered channel equilibrium. Fine sediments and other habitat characteristics influencing survival and growth are consistent with the desired conditions for the habitat. The subpopulation has the resilience to recover from short-term disturbance within one to two generations (5-10 years). The subpopulation is fluctuating around an equilibrium or is growing.	Fine sediments, stream temperatures, or the availability of suitable habitats have been altered and will not recover to pre-disturbance conditions within one generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The subpopulation is reduced in size, but the reduction does not represent a long-term trend. The subpopulation is stable or fluctuating in a downward trend.	Cumulative disruption of habitat has resulted in a clear declining trend in the subpopulation size. Under current management, habitat conditions will improve within two generations (5 to 10 years. Subpopulation survival and recruitment responds sharply to normal environmental events.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Integration of Pathways (bull trout)			
	Habitat quality and connectivity among local populations is high. The migratory form is present. Disturbance has not altered channel equilibrium. Fine sediments and other habitat characteristics influencing survival and growth are consistent with pristine habitat. The local population has the resilience to recover from short-term disturbance within one to two generations (5 to 10 years). The local population is fluctuating around an equilibrium or is growing.	Fine sediments, stream temperatures, or the availability of suitable habitats have been altered and will not recover to pre-disturbance conditions within one generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The local population is reduced in size, but the reduction does not represent a long-term trend. The local population is stable or fluctuating in a downward trend. Connectivity among the local populations occurs but habitats are more fragmented.	Cumulative disruption of habitat has resulted in a clear declining trend in the subpopulation size. Under current management, habitat conditions will improve within two generations (5 to 10 years). Little or no connectivity remains among local populations. Local population survival and recruitment responds sharply to normal environmental events.
Integration of Pathways (other fish species, i.e., redband, rainbow, wood river sculpin, etc.)			
	Species-specific criteria should be developed.		

Table B-2. Environmental Baseline – Current Conditions

Agency/Unit:		HU Code & Name:	
Fish Species Present:		Spatial Scale of Matrix:	
(Anad. Sp.) Population:		Subpopulation:	
(Bull trout) Core Area:		Local Population:	
Management Action(s):			

Pathways Indicators [a, c]	Population and Environmental Baseline		
	Desired Condition	☒ = Data Baseline [b]	Discussion of Baseline – Current Condition
Subpopulation Character			
Subpopulation Size			
Growth and Survival			
Life History Diversity and Isolation			
Persistence and Genetic Integrity			
Water Quality			
Temperature			
Sediment			
Chemical Contaminants/Nutrients			
Habitat Access			
Physical Barriers			
Habitat Elements			
Substrate Embeddedness			
Large Woody Debris			
Pool Frequency			
Pool Quality			
Off-Channel Habitat			
Refugia			

a. Matrix checklist adapted from USFWS and NMFS 1998.
b. FA = Functioning Appropriately, FR = Functioning at Risk, UR = Functioning at Unacceptable Risk, N = Not Applicable
note: "☒" in baseline discussion indicates actual data were used as the primary source of baseline assessment, otherwise reflects a professional estimate of condition.
c. Evaluated against local criteria where appropriate and available (see IV.C)

Table B-2. Environmental Baseline – Current Conditions (continued)

Pathways Indicators [a, c]	Population and Environmental Baseline		
	Desired Condition	☒ = Data Baseline [b]	Discussion of Baseline – Current Condition
Channel Condition and Dynamics			
Width/Depth Ratio			
Stream bank Condition			
Floodplain Connectivity			
Flow/Hydrology			
Change in Peak/Base Flows			
Drainage Network Increase			
Watershed Conditions			
Road Density and Location			
Disturbance History			
Riparian Conservation Areas			
Disturbance Regime			
Integration of Species and Habitat Conditions			

a. Matrix checklist adapted from USFWS and NMFS 1998.
b. FA = Functioning Appropriately, FR = Functioning at Risk, UR = Functioning at Unacceptable Risk, N = Not Applicable
note: "☒" in baseline discussion indicates actual data were used as the primary source of baseline assessment, otherwise reflects a professional estimate of condition.
c. Evaluated against local criteria where appropriate and available (see IV.C)

Table B-3. Effects of Management Actions

Agency/Unit:		HU Code & Name:	
Fish Species Present:		Spatial Scale of Matrix:	
(Anad. Sp.) Population:		Subpopulation:	
(Bull trout) Core Area:		Local Population:	
Management Action(s):			

Pathways Indicators [a, d]	Effects of the Management Action(s)				
	Effects [b, c]	Temporary trend/effect (+/-/none)	Short-term trend/effect (+/-/none)	Long-term trend/effect (+/-/none)	Discussion of Effects
Subpopulation Character					
Subpopulation Size (bull trout only)					
Growth and Survival (bull trout only)					
Life History Diversity and Isolation (bull trout only)					
Persistence and Genetic Integrity (bull trout only)					
Water Quality					
Temperature					
Sediment					
Chemical Contaminants/ Nutrients					
Habitat Access					
Physical Barriers					
Habitat Elements					
Substrate Embeddedness					
Large Woody Debris					
Pool Frequency					
Pool Quality					
Off-Channel Habitat					
Refugia					

a. Matrix checklist adapted from USFWS and NMFS1998.
b. This displays the potential effects of the action on habitats or individuals, and not on the status of the entire local population/ watershed. I = Improve, M = Maintain, D = Degrade, N = No Influence
c. Effects that "Maintain" or "Improve" indicators are compliant with Pacfish and Infish objectives (see USFWS 1998 for crosswalk).
d. Evaluated against local criteria where appropriate and available (see IV.C)

Table B-3. Effects of Management Actions (continued)

Pathways Indicators [a, d]	Effects of the Management Action(s)				
	Effects [b, c]	Temporary trend/effect (+/-/none)	Short-term trend/effect (+/-/none)	Long-term trend/effect (+/-/none)	Discussion of Effects
Channel Condition and Dynamics					
Width/Depth Ratio					
Stream bank Condition					
Floodplain Connectivity					
Flow/Hydrology					
Change in Peak/Base Flows					
Drainage Network Increase					
Watershed Conditions					
Road Density and Location					
Disturbance History					
Riparian Conservation Areas					
Disturbance Regime					
Integration of Species and Habitat Conditions					

a. Matrix checklist adapted from USFWS and NMFS1998.
b. This displays the potential effects of the action on habitats or individuals, and not on the status of the entire local population/watershed. R = Restore, M = Maintain, D = Degrade, N = No Influence
c. Effects that “Maintain” or “Improve” indicators are compliant with Pacfish and Infish objectives (see USFWS 1998 for crosswalk).
d. Evaluated against local criteria where appropriate and available (see IV.C)

Table B-4. Dichotomous Key For Making ESA Determination Of Effects
(Circle the conclusion at which you arrive)

Name and location of action:

1. Are there any proposed/listed fish species and/or proposed/designated critical habitat in the watershed or downstream from the watershed?

   NO . . . . No Effect
   YES . . . . .Go to 2[1]

2. Will the proposed action(s) have any effect whatsoever[1] on the species and/or critical habitat?

   NO . . . . No Effect
   YES . . . . Go to 3

3. Does the proposed action(s) have the potential to hinder attainment of relevant properly functioning indicators (from Table II)?

   NO . . . . Go to 4
   YES . . . . Likely to adversely affect[2]

4. Does the proposed action(s) have the potential to result in "take"[2] of proposed/listed fish species or adversely affect proposed/designated critical habitat?

   a) There is a negligible (extremely low) probability of take of proposed/listed fish species, or of adversely affecting proposed/designated critical habitat…Not likely to adversely affect

   b) There is more than a negligible probability of take of proposed/listed fish species or of adversely affecting proposed/designated critical habitat…Likely to adversely affect[2]

[1] "Any effect whatsoever" includes small effects, effects that are unlikely to occur, and beneficial effects (all of which are recognized as "may affect" determinations). A "no effect" determination is only appropriate if the proposed action will literally have no effect whatsoever on the species and/or critical habitat, not a small effect, an effect that is unlikely to occur; or a beneficial effect.

[2] "Take" – The ESA (Section 3) defines take as "to harass, harm, pursue, hunt, shoot, wound, trap, capture, collect, or attempt to engage in any such conduct". The USFWS (USFWS, 1994) further defines "harm" as "significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering", and "harass" as "actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering". ". In 1999, NMFS (64 FR 60727) further defined harm to include "spawning" and "rearing" as additional behavioral patterns.

[3] Document expected incidental take on next page of this key.

Modification Considerations For Pathways And WCIs

This section is intended to provide a basis for general modification of the WCIs contained in the Matrix and recommendations for data sources or evaluation.

WCIs are an integrated suite of aquatic (including biophysical components), riparian (including riparian-associated vegetation species), and hydrologic (including uplands) condition measures that are intended to be used at the a variety of watershed scales. They assist in determining the current condition of a watershed and should be used to help design appropriate management actions or alter or mitigate proposed and or ongoing actions to move watersheds toward desired conditions. Common sources of information are likely to include Forest Service and other agencies' habitat and population surveys, walk-through surveys, professional judgment, and monitoring and remote sensing data.

The following descriptions are generated to stimulate discussions on Level I teams associated with listed fish species, and Interdisciplinary Teams on evaluations of all the WCIs/Pathways through which riparian functions and ecological processes, aquatic habitat, and fish populations can be altered. These descriptions are not all inclusive, and it is recommended that both field review and literature review be conducted to better understand the inherent variability and interactions of the biophysical resources for any management action within a given watershed.

Use of fairly comprehensive databases such as the "Natural Conditions Dataset" (Overton et al. 1995), may be useful in developing more localized values. Where appropriate, refinement of WCI values can be stratified by several geoclimatic variables, some of which include: geomorphology, landform, stream type and size, climate historic, and potential vegetation.

Pathway: Bull Trout Local Population Characteristics Within Core Areas

WCI–1: Local Population Size. DATA AND ANALYSIS: Determinations of baseline will reflect the known status of the local population as compared against the numeric criteria. Definitions of functionality are derived from Rieman & McIntyre (1993). Determination of baseline "current condition" will reflect the known status of the local population as compared against the numeric criteria.

Utilize primarily professional judgment, or data where available. No criteria for species other than bull trout are needed. Most information sources will reflect only confirmed presence or assumed absence. Where population surveys exist, the data may be sufficient to apply the numeric criteria in Table I, but will unlikely represent the true "population". It may be difficult in some watersheds to separate historic non-use from contemporary non-use, that is, was the species ever present? For the purpose of consistency, the numeric criteria should be applied as written, unless evidence exists to demonstrate historic non-use.

WCI–2: Growth and Survival. DATA AND ANALYSIS: It is unlikely that 5 to 10 years of data exists to support any baseline assessment, as identified in Table I; therefore, analysis should use available data and information to arrive at a professional estimate of the condition. Inferences may be derived from related information such as water temperature or macro-invertebrate data. Unknowns suggest a conservative application of the numeric criteria as written. No criteria for species other than bull trout are needed. Use professional judgment.

The ratio of adults to pre-adults and the extent of the available habitat are used to estimate productivity for growth and survival. Bull trout greater than 6 inches in length are assumed to be adult fish (based on age analyses of resident fish collected on the Forest).

WCI–3: Life History Diversity and Isolation. DATA AND ANALYSIS: Utilize primarily professional judgment, or data where available. Most information sources will reflect only confirmed presence or assumed absence. Known connectivity and past observation of larger migratory bull trout can assist in estimating the current condition. Where neighboring local population surveys exist, the data may be sufficient to apply the matrix standards. Unknowns suggest a conservative application of the numeric criteria as written. No criteria for species other than bull trout are needed.

WCI–4: Persistence and Genetic Integrity. DATA AND ANALYSIS: Utilize primarily professional judgment, or data where available. Most information sources will reflect only confirmed presence or assumed absence. Where neighboring local population surveys exist, the data may be sufficient to apply the Matrix criteria. Unknowns suggest a conservative application of the numeric criteria as written. No criteria for species other than bull trout are needed.

Pathway: Water Quality

WCI–1: Temperature. DATA AND ANALYSIS: Recording thermographs, both within the habitats of concern and during the applicable timeframes (e.g., spawning, rearing, and migration periods), will be required to directly evaluate the Matrix parameters. Spot measurements are typically not sufficient, but could be used to indicate a temperature extreme that warrants further examination. Daily thermograph maximums need not be further processed into 7-day average unless necessary to discriminate between baseline conditions. For spawning temperature criteria, conditions need to meet the criteria throughout the spawning period.

WCI–2: Sediment/Turbidity. DATA AND ANALYSIS: Unless sufficient data/information is available to determine otherwise, no baseline condition will be identified as "functioning appropriately" for any reach within a watershed that is currently included on the 303(d) impaired water body list with sediment identified as the pollutant. If sufficient information is available to dispute the listing, it may be considered "functioning at risk"; otherwise, a 303d listing for sediment will be considered "functioning at unacceptable risk". The values for this indicator may vary greatly and should be refined to better reflect local conditions (geoclimatic setting). Modification of the sediment criteria can utilize the more localized Natural Conditions Dataset (Overton et al. 1995) to incorporate the local geomorphology, landform, stream type and size, potential vegetation type for the stream reach or subwatershed. Surface fines are currently being used as a surrogate for turbidity. If surface fine information is not available, naturally erosive soils and/or stream bank condition indicator may be used in it place. In watersheds with ESA-listed fish species, consult with the Level 1 consultation team before making changes.

WCI–3: Chemical Contamination/Excess Nutrients. DATA AND ANALYSIS: Consider rates of chemical and a nutrient source of contamination only; do not include sediment or temperature (the basis for listing most 303d streams). Where available, utilize appropriate state and federal water quality rules and regulations.

Pathway: Habitat Access

WCI–1: Physical Barriers. DATA AND ANALYSIS: This indicator identifies the known and or potential barriers to fish movement both within a local population and among core areas. This includes but is not limited to dams, culverts, bridges, and fords, as well as barriers associated with thermal or chemical alterations to the water column. Estimation on the amount and extent of fish barriers may be completed using GIS layers of roads (classified and unclassified) and the 1:24,000 streams layer. Natural barriers such as waterfalls, cascades, and elevated stream temperatures from hot springs are important to identify, but should not have an influence on the functionality rating.

Pathway: Habitat Elements

WCI–1: Substrate Embeddedness. DATA AND ANALYSIS: This indicator identifies the extent to which larger particles are embedded or buried by fine sediment. A commonly used procedure for measuring embeddedness is by selecting particles from the streambed and then measuring both the particle height and embedded height perpendicular to the streambed surface. Percent embeddedness is calculated for each particle until at least 100 particles are measured. The values for this indicator may vary greatly and should be refined to better reflect local conditions (geoclimatic setting).

WCI–2: Large Woody Debris. DATA AND ANALYSIS: The indicator considers the number and size of in-channel wood, as well as future recruitment of wood in RCAs. A number of methods can be used to collect in-channel wood data. Most surveys count only those pieces that extend below the waterline at bankfull discharge and exceed some minimum size limit over a specific stream distance. Sometimes spanners or bridged pieces are also included in the count. An adequate source of wood recruitment is generally an estimate of the number of pieces that may fall into the stream in the future. This information is commonly collected through a walk-through survey or intensive riparian survey. Several studies have shown that most (70 to 90 percent) large wood recruited to streams is from trees growing within 65-100 feet of the channel on flat terrain (Murphy and Koski 1989, McDade et al. 1990). Potential wood recruitment should at a minimum be considered within one site potential tree height. This height will vary by potential vegetative group (PVG), and can range from 50 feet in PVG 11 to 120 feet in PVG 1. Analysis should be cognizant of the distribution of terrestrial vegetation habitats within the watershed. For example, stream reaches flowing through broad shrub-dominated meadows lack natural sources of LWD, and would not be expected to meet the numeric criteria. Generally, watersheds or stream reaches with a mosaic of conifer and shrub habitats would be considered at desired conditions unless evidence displays manipulation or disturbance of streamside forests, regardless of LWD numeric levels.

WCI–3: Pool Frequency and Quality. DATA AND ANALYSIS: This indicator is based on the number of pools meeting a minimum size criteria defined by the appropriate methodology by channel width. It also considers the amount of cover in each pool, water temperature, and filling by sediment. Most stream surveys have typically considered this habitat element. "Pocket pools" or other such quantified microhabitat can also be appropriately considered as pools. Where data is lacking, use professional judgment with inference from related mechanisms such as known disturbance within the watershed (e.g., an increase in sediment loads will generally result in a decrease in pool frequency and quality).

WCI–4: Large Pools. DATA AND ANALYSIS: This indicator is based upon the number of pools with maximum depth greater than 3.28 feet. It also considers the amount of cover in each pool, water temperature, and filling by sediment. Most stream surveys have typically considered this habitat element. The values for this indicator may vary greatly and should be refined to better reflect local conditions (geoclimatic setting).

WCI–5: Off-Channel Habitat. DATA AND ANALYSIS: This indicator is based upon the number of side channels, ponds, oxbows, and other backwater areas. Typically this is a measure of either the total number of these habitat types or the total linear distance over a specific reach. Utilize available data and information with professional judgment. Some habitat surveys have quantified conditions in off-channel habitats, and most have at least commented about the existence of such. However, no numeric standard exists.

WCI–6: Refugia. DATA AND ANALYSIS: This is a large-scale indicator based upon the quality, uniqueness, and importance of the 6th or 5th field HU the project being analyzed falls within. Utilize available data and tools, such as aerial photos, with professional judgment. This indicator speaks to the current situation of habitats within the local –population--that is, within the watershed.

Pathways: Channel Conditions and Dynamics

WCI–1: Average Width/Maximum Depth Ratio. DATA AND ANALYSIS: The determination of channel width and channel depth is problematic because both parameters are flow-dependent. Depth tends to increase with flow more rapidly than width, but this relationship may not be constant at any given cross-section. Recent surveys have typically evaluated only wetted channel conditions. Maximum depth identification requires specialized abilities in identifying bankfull features and so has not been consistently collected. Ideally these parameters should be measured at specific discharges and locations. Where no data exists, those familiar with the stream can compare visual observations of it with stream references such as found in the Natural Conditions Dataset (Overton et al. 1995), or Applied River Morphology (Rosgen 1996). The values for this indicator may vary greatly by channel type and should be refined to better reflect local conditions (geoclimatic setting). Utilize available data and information, or professional judgment.

WCI–2: Streambank Condition. DATA AND ANALYSIS: Many stream surveys have evaluated streambank condition (stability), although until recently it was rarely quantified. Where quantified, if summarized by habitat type, this indicator can be evaluated as in the USFWS matrix; that is, what portion of the habitat units have at least 90 percent stable banks. However, if summarized only by reach, simply consider the portion of the total length that is "stable". Engineered revetment should generally not be considered "stable". Where no quantitative data exists, qualitative assessments common in the 1980s such as the Stream Reach Inventory and Channel Stability Evaluation (Pfankuch 1975) can provide considerable inference. Utilize available data and information, or professional judgment.

WCI–2: Floodplain Connectivity. DATA AND ANALYSIS: This indicator is based on whether floodplains and wetlands are hydrologically linked to the main channel. Evidence of channel entrenchment, manipulation, levees, revetment, or alteration should be absent to be considered "functioning appropriately". This indicator is closely related to variations in local geomorphology, landform, stream size and type, climate, and potential vegetation. Utilize primarily professional judgment, or data, information, or photographs if available.

Pathway: Flow/Hydrology

WCI–1: Change in Peak or Base Flows. DATA AND ANALYSIS: This indicator is typically based on field observations and an assessment of management impacts at the 6th or 5th field HU scales. In-channel observations may include channel adjustments such as nick points; scour marks, and eroding banks to dewatered streams. Larger-scale measurements may include past harvest history, road densities and location, and acres burned. Utilize primarily professional judgment, or data and information if available.

WCI–2: Changes in Drainage Network. DATA AND ANALYSIS: This indicator is typically based on field observations and an assessment of management impacts at the 6th or 5th field HU scales. Management activities typically observed are roads with extensive inside ditches and few relief culverts, dewatered or expanded streams below roads, compacted ground within harvest units, and intensive livestock grazing. Utilize primarily professional judgment, or data and information if available.

Pathway: Watershed Conditions

WCI–1: Road Density and Location. DATA AND ANALYSIS: Classified and unclassified road densities and miles within the RCAs can quickly be evaluated, particularly with GIS tools. Utilize available data and information, or professional judgment. Road density default values are from the "Supplemental Roads Analysis of Road Impacts pages 1253-1260 in Volume III of Quigley and Arbelbide, 1997.

WCI–2: Disturbance History. DATA AND ANALYSIS: This indicator is typically based on vegetative recovery from disturbance. The values for this indicator may vary greatly from the default values and should be refined to better reflect local conditions. Local refinements of these indicator values should consider local research data (e.g., Silver Creek Watershed Research Projects, King 1989). It is difficult to predict how much a particular change in ECA will affect watershed function and effect on salmonids; therefore professional judgment will be required.

WCI–3: Riparian Conservation Areas. DATA AND ANALYSIS: Actions and historic disturbance within an RCA can help infer RCA condition and trend. Classified and unclassified roads and number of stream crossings can also be quickly evaluated within a given watershed, particularly with GIS tools. Utilize primarily professional judgment, or data, tabular information, or aerial photographs if available.

WCI–4: Disturbance Regime. DATA AND ANALYSIS: Ecological processes including the disturbance processes that create dynamic soil, water, and hydrologic, riparian and aquatic habitats within watersheds. The results of these processes determine the physical and biological capability within watersheds, including water quality and aquatic habitat. Differences in climate, geomorphology, soils, and potential vegetation (geoclimatic setting) greatly influence the amount and recurrence of disturbance process (disturbance regimes), as well as the ability and rate for a subwatershed to recover (resiliency). The intent of this indicator is to determine the amount of effect that land management activities have or may have on the overall watershed function and resiliency. Utilize primarily professional judgment, based on available data and information when available.

Pathway: Integration of Species and Habitat Conditions

No individual WCIs identified. DATA AND ANALYSIS: This pathway is an integration of the biophysical and aquatic habitat conditions. Individual WCIs represent a starting point to describe the current and desired conditions for water quality and aquatic habitat. This pathway synthesizes the information evaluated for individual indicators to determine the overall functional status of the subwatershed. Utilize professional judgment and reference specific WCIs that have a major influence on the overall condition.

GUIDANCE FOR DELINEATION AND MANAGEMENT OF RIPARIAN CONSERVATION AREAS

Introduction

The third component of the ACS is the delineation of RCAs. Naiman et al. (2000) identifies that recent discoveries about the structure and dynamics of riparian zones have extended the scope of understanding about this portion of the landscape and have important implications for stream and watershed management. The following guidance has been developed to assist interdisciplinary teams in becoming familiar with and consistently applying criteria to: (1) appropriately delineate RCAs; and (2) analyze important considerations in developing appropriate management actions within or affecting RCAs. The objective is to ensure that interdisciplinary teams adequately consider riparian functions and ecological processes in both the delineation of RCAs and determination of appropriate management actions within or affecting RCAs.

The revised Forest Plan direction (goals, objectives, standards, and guidelines) found in Chapter III of this document replaces direction in the 1990 Boise National Forest Land and Resource Management Plan, as amended by Pacfish/Infish, NMFS' 1995 LRMP Biological Opinion (BOs), and the NMFS' and USFWS' 1998 Biological Opinions for steelhead and bull trout. With that replacement, the definitions and delineations of Pacfish/Infish Riparian Habitat Conservation Areas are replaced by the definitions and delineations of RCAs.

Overview Of The RCA Delineation Guidance

Aquatic and riparian systems are easily affected by land management activities on the surrounding hillslopes. RCAs provide both a linkage and transitional habitat between hillslopes and upland terrestrial habitats and the aquatic habitats within stream channels.

In general, there is little controversy over the need to define RCAs in order to maintain riparian functions and ecological processes. The controversy is over the width of the RCA, the extent and type of management activities that can occur within them, and the purposes for those activities. Management activities that occur within, or adjacent to, an RCA are subject to specific goals, objectives, standards and guidelines. Forest plans and the associated management direction regulate two major features of RCAs: (1) their width; and (2) the kind and amount of activity that can take place within or influence them (Spence et al. 1996, Quigley and Arbelbide 1997).

Riparian zones are among the biosphere's most complex ecological systems and also among the most important for maintaining the vitality of the landscape and its rivers (Naiman et al. 2000). Evaluating the effectiveness of RCAs to manage for riparian functions and ecological processes is difficult because of: the complexities of such areas, the extended time over which impacts can occur; and the resiliency and rate of recovery. The RCA should be designed to maintain riparian functions and ecological processes with consideration of multiple scales (stream reach, subwatershed, and watershed scale).

RCA Delineation Criteria For the Boise National Forest

The following are criteria to be used to delineate RCAs for perennial and intermittent streams, ponds, lakes, reservoirs, and wetlands.

I. Forested Streams*
Perennial streams (and intermittent streams providing seasonal rearing and spawning habitat) **–**
In the absence of local field data, 300-foot slope distance from the ordinary high water mark,
OR
Flood-prone width or two site-potential tree heights, whichever is greatest,
OR
Defined based on a site-specific analysis by a qualified specialist with expertise in the field of riparian function and ecological processes.

II. Forested Streams*
Intermittent streams – In the absence of local field data, 150-foot slope distance from the ordinary high water mark,
OR
Flood-prone width or one site-potential tree height, whichever is greatest,
OR
Defined based on a site-specific analysis by a qualified specialist with expertise in the field of riparian function and ecological processes.

III. Ponds, Lakes, Reservoirs, and Wetlands*
In the absence of local field data, 150-foot slope distance from the ordinary high water mark,
OR
Outer edge of seasonally saturated soils, outer edge of riparian vegetation, or one site-potential tree height, whichever is greatest,
OR
Defined based on a site-specific analysis by a qualified specialist with expertise in the field of riparian function and ecological processes.

IV. Non-Forested Streams*
Perennial and intermittent streams –
The extent of the flood prone width, or riparian vegetation, whichever is greatest,
OR
Defined based on a site-specific analysis by a qualified specialist with expertise in the field of riparian function and ecological processes.

*Note: Sediment delivery distances vary based upon the combination of proposed management actions and the inherent site characteristics. Because sediment delivery distances may exceed the selected option, RCAs may need to be adjusted to avoid or minimize delivery to the associated water body under any option.

Step-Down Process For RCA Delineation

Effective use of the RCA delineation requires a full understanding of the selection criteria options within each of the four Categories.

Delineating an RCA requires two decisions to be made. First, the area needs to be correlated with one of the four Categories (I, II, III, or IV). The second decision is identifying which option, or criteria, within that Category to use.

The decision as to which option or criteria should be chosen should occur through discussions with the interdisciplinary team, resource specialists, and/or the line officer. In general, determining the level of analysis that best suits the needs of the project will be driven by the potential effects of the project, baseline conditions, management direction, and issues associated with the project/area of interest that were identified through scoping, the work of the interdisciplinary team, or the line officer.

Written documentation of the chosen RCA delineation option within a category, and the rationale behind the choice, should be included in record documentation for the project.

The options within a given Category have varying levels of associated analysis that are involved with delineating the RCA. Category IV, Non-forested Streams, differs from the other Categories in that it does not designate a set distance and therefore has two options rather than three.

Option 1

In lieu of field data, selection of the first option provides a conservative boundary--generally in excess of two site-potential tree heights in the case of the 300-foot slope distance, and greater than one site-potential tree height in the case of the 150-foot slope distance--that would be expected to account for most riparian processes including stream shading, LWD recruitment, fine organic litter input, bank stabilization, sediment filtration, wind-throw, riparian microclimate and productivity, and wildlife habitat. Again, selection of this option is expected to provide land managers with the option of delineating an RCA in the absence of field confirmation, with the expectation that the distances would account for most riparian functions andecological processes in a system.

Option 2

The second criteria option, which is used similarly in Categories I-IV, requires field verification of certain site characteristics and provides a more site-based delineation of an RCA boundary for a specific location. Depending on which Category (I, II, III, or IV) is involved, options include use of flood-prone width, site-potential tree height, or riparian vegetation, whichever is greatest given the category.

Flood-prone width is a relatively easily surveyed geomorphic feature in the field, and it accounts for riparian processes, such as fine organic litter input or bank stabilization, and for various degrees of sediment delivery distances.

Site-potential tree height is spoken to in the literature and correlated with the protection of riparian functions and ecological processes such as stream shading, LWD recruitment, fine organic litter input, bank stabilization, sediment filtration, wind-throw, riparian microclimate and productivity, and wildlife habitat (Spence et al. 1996, Quigley and Arbelbide 1997, FEMAT 1993).

Riparian vegetation is defined through classification of the vegetation associated with the aquatic habitat and its outer extent (see glossary), and it generally influences riparian processes such as fine organic litter input, bank stabilization, sediment filtration, stream shading, and wildlife habitat.

Option 2 requires the use of certain field data to be collected from the project area and analyzed to determine the RCA boundary. It is considered an option requiring potentially less than a site-specific analysis (Option 3), but it is more appropriately tied to the landscape than a default distance might be (Option 1).

Option 3

The third option, which is used in Categories I-IV, is the use of a site-specific analysis to define the RCA. This option requires potentially the most analysis of the three options. When defining the RCA, the specialist conducts an on-site analysis of the riparian functions and ecological processes associated with the stream, pond, lake, reservoir or wetland, and defines the RCA based on the distance that best encompasses the extent of those functions and processes. The value gained from this effort is a site-specific RCA delineation appropriate to the functions and processes between upland terrestrial habitats and adjacent aquatic habitats for that area. This information potentially provides more opportunities for project design because the existing condition is better known, and therefore effects of actions can be better assessed, and projects can be more responsive to needs of the aquatic ecosystem.

In summary, RCA delineation is set up in a manner that provides flexibility for different levels of analysis that, regardless of the option chosen, will provide for riparian functions and ecological processes. The decision on which option to use must involve considerations of the project in regard to potential effects, baseline conditions, and issues and their relationship to riparian functions and ecological process.

The effectiveness of delineating an accurate RCA provides decision-makers with the information necessary for sound decisions regarding management activities within a watershed. With an understanding of the riparian functions and ecological processes of a system, and the means by which actions may affect them, decision makers are provided an opportunity to design activities to maintain or restore listed fish species, their habitats, and other SWRA resources.

Flood-Prone Width For Use In Identifying RCAs

Rosgen (1996) identifies an acceptable field methodology for determining the flood-prone area width. To measure the width of the flood-prone area, select the elevation that corresponds to twice the maximum bankfull channel depth as determined by the vertical distance between bankfull stage and the thalweg of a riffle. The flood-prone area generally includes the active floodplain and the low terrace (Rosgen 1996). This area can assist to varying degrees in the protection for: stream shading, LWD recruitment, fine organic litter, bank stabilization, sediment filtration, nutrients and other dissolved materials, riparian microclimate and productivity, wildlife habitat, and windthrow.

Flood-prone width, as defined by Rosgen (1996), will vary greatly depending on valley form and channel entrenchment. For example, flood-prone widths would be expected to be narrower in confined, entrenched streams, and wider in broad valley forms with less entrenched streams. Because site-potential tree heights will typically provide a wider RCA in confined, entrenched streams, flood-prone width will not typically be used to define RCAs in these stream types. Similarly, flood-prone width will be more likely to be used in the broad valley forms with low channel entrenchment.

Site-Potential Tree Heights For Use In Identifying RCAs

When planning and implementing vegetation management projects, distances equivalent to one or two site-potential tree heights may be used to determine RCA boundaries, provided a site visit has been completed. Current conditions and dominant potential vegetation group (PVG) for the site/project area must be verified in the field.

Once the dominant PVG has been field-verified, the site-potential tree height criteria in the following table will be used to determine RCA widths in the management units. See the glossary in this appendix for definitions of site-potential tree height, site tree, and seral tree species. For more information about forested vegetation and PVGs, refer to Appendix A of the Forest Plan.

Table B-5. Site Potential Tree Heights by Potential Vegetation Group

Potential Vegetation Group	Age	1 Site Tree Height (feet)	2 Site Tree Heights (feet)
1 - Dry Ponderosa Pine/Xeric Douglas-fir	200	110	220
2 - Warm Dry Douglas-fir/Moist Ponderosa Pine	200	120	240
3 - Cool Moist Douglas-fir	200	120	240
4 – Cool Dry Douglas-fir	200	100	200
5 – Dry Grand Fir	200	110	220
6 – Cool Moist Grand Fir	200	130	260
7 – Cool Dry Subalpine Fir	200	100	200
8 – Cool Moist Subalpine Fir	200	100	200
9 - Hydric Subalpine Fir	200	100	200
10 - Persistent Lodgepole Pine	*	80	160
11 - High Elevation Subalpine Fir	200	70	140

*In PVG 10 individual trees and stands normally do not achieve an average of 200 years. However, mature lodgepole pine site trees can achieve an average height of approximately 80 feet.

Riparian Functions And Ecological Processes: Considerations

The determination of RCA widths must consider the various riparian functions and ecological processes that exert an influence on the adjacent aquatic and terrestrial environment. Integral to the success of proper management, is an understanding of riparian functions and ecological processes, and local knowledge of the site being managed. With field data in hand, design of an appropriate RCA width can focus on conservation of appropriately functioning processes and restoration of damaged processes of concern based on the existing conditions of the site, proposed activities, and issues at hand.

Megahan and Hornbeck (2000) state that a properly designed and managed riparian area can provide a variety of amenities, while protecting riparian functions and ecological processes and diversity of species composition. They further state that a properly designed and managed riparian area includes careful management of forests both within, and outside of the riparian area.

Spence et al. (1996) and Quigley and Arbelbide (1997) identify several important considerations when appropriately delineating and designing management activities within or affecting RCAs. These are as follows:

a) A stream requires predictable and near-natural energy and nutrient inputs.
b) Many plant and animal communities rely on streamside or wetland forests and vegetation for migratory or dispersion habitat.
c) Small streams are generally more affected by hillslope activities than are larger streams.
d) As adjacent slopes become steeper, the likelihood of disturbance resulting in discernable instream effects increases.
e) Riparian vegetation 1) provides shade to stream channels; 2) contributes large woody debris; 3) adds small organic matter; 4) stabilizes stream banks; 5) controls sediment inputs from surface erosion; 6) and regulates nutrient and pollutant inputs to streams.

Taking a functional approach to delineating an RCA by looking at "zones of influence" (Spence et al. 1996) allows the qualified specialist to focus on specific riparian functions where a relationship between those functions and RCA widths are known. The 'zone of influence' approach provides the qualified specialist a means to distinguish between those riparian functions and ecological processes potentially affected by the proposed actions and those that, regardless of the RCA delineation, the proposed actions will not impair. The functions and processes that would be unaffected by the proposed action, regardless of the RCA delineation, could then be dropped from further discussion. When defining the RCA through site-specific analysis this rationale should be documented.

The riparian functions and processes that may be affected by the proposed action(s) (given the existing conditions and associated issues) should then be addressed through the RCA delineation. In general, the riparian functions and ecological processes that should be considered during delineation of RCAs through site-specific analysis include (taken primarily from Spence et al. 1996):

- Stream Shading
- Large Woody Debris Recruitment
- Fine Organic Litter
- Bank Stabilization
- Sediment Control
- Nutrients and Other Dissolved Materials
- Riparian Microclimate and Productivity
- Wildlife Habitat
- Windthrow
- Importance of Small Streams
- Importance of Hillslope Steepness

The following are brief discussions on some of the riparian functions and ecological processes that are intended to assist the practitioner in a thorough analysis.

Stream Shading (excerpted from Spence et al. 1996)
The ability of riparian forests to provide shade to stream channels is a function of numerous site-specific factors including vegetation composition, stand height, stand density, latitude (which determines solar angle), topography, stream width, and orientation of the stream channel. These factors influence how much incident solar radiation reaches the forest canopy and what fraction passes through to the water surface. The shading influence of an individual tree can be expressed geometrically as a function of tree height, slope, and solar angle. In natural forests, stand density and composition may moderate the shading influence of trees within this zone, with trees closer to the stream channel and understory shrubs providing the majority of stream shade.

More research on riparian influences on shading for all ecosystems east of the Cascades is needed; however, in most instances, RCA widths designed to protect other riparian functions (e.g., LWD recruitment) are likely to be adequate to protect stream shading.

Large Woody Debris Recruitment (excerpted from Spence et al. 1996)
Large wood enters stream channels by a variety of mechanisms, including toppling of dead trees, windthrow, debris avalanches, deep-seated mass soil movements, undercutting of streambanks, and redistribution from upstream. In some systems, wood delivered from upslope areas (via land-sliding) or upstream reaches (via floods or debris torrents) may constitute a significant fraction of the total wood present in a stream reach. When evaluating RCAs, consideration should be given to potential recruitment of wood from upslope areas and non-fish-bearing channel in addition to wood delivered by toppling, windthrow, and bank undercutting.

The potential for a tree or portions of a tree to enter the stream channel by toppling, windthrow, or undercutting is primarily a function of slope distance from the stream channel in relation to tree height and slope angle. Consequently, the zone of influence for large wood recruitment is defined by the particular stand characteristics rather than an absolute distance from the stream channel or floodplain. Other factors, including slope and prevailing wind direction, may influence the proportion of trees that fall in the direction of the stream channel.

Fine Organic Litter (excerpted from Spence et al. 1996)
Smaller pieces of organic litter (leaves, needles, branches, tree tops, and other wood) enter the stream primarily by direct leaf or debris fall, although organic material may also enter the stream channel by overland flow of water, mass soil movements, or shifting of stream channels in unconstrained reaches. Little research has been done relating litter contributions to streams as a function of distance from the stream channel; however, it is assumed that most fine organic litter originates within 30 meters, or 0.5 potential tree heights from the channel.

Bank Stabilization (excerpted from Spence et al. 1996)
Roots of riparian vegetation help to bind soil particles together, making streambanks less susceptible to erosion. In addition, riparian vegetation provides hydraulic roughness elements that dissipate stream energy during high or overbank flows, further reducing bank erosion. In most instances, vegetation immediately adjacent to the stream channel is most important in maintaining bank integrity; however, in wide valleys with shifting stream channels, vegetation throughout the floodplain may be important over longer time periods. Although data quantifying the effective zone of influence relative to root strength is scarce, most of the stabilizing influence of riparian root structure is probably provided by trees within 0.5 potential tree heights of the stream channel. Consequently, delineating RCA widths to provide for other riparian functions (e.g., LWD recruitment, shading) are likely to maintain bank stability. In addition, consideration should be given to the composition of riparian species within the area of influence because of differences in the root morphology of conifers, deciduous trees, and shrubs. Specific relationships between root types and bank stabilization have not been documented; however, if the purpose of riparian protection is to restore natural bank characteristics, then retaining natural species composition is a reasonable target for maintaining bank stabilization function of riparian vegetation.

Sediment Control and Importance of Hillslope Steepness (excerpted from Quigley & Arbelbide 1997)
The ability of RCAs to control sediment input from surface erosion depends on several site characteristics including the presence of vegetation or organic litter, slope steepness and slope roughness, soil type, and drainage characteristics. These factors influence the ability of vegetation to trap sediments by determining the infiltration rate of water and the velocity (and hence the erosive energy) of overland flow.

The likelihood of disturbance resulting in discernible instream effects increases as adjacent slopes become steeper. Thus, greater preventive measures to avert negative effects to streams, or restore riparian function and ecological processes on steeper slopes may be required to prevent or reduce instream effects. The designation of RCA widths can easily incorporate the major topographic driver of surface erosion and slope steepness.

Prior research on a variety of wildland and agricultural settings has demonstrated that surface erosion increases with increasing slope steepness, although the increase is not linear. The effect of slope has generally been modeled empirically, and has taken the shape of a power function where the exponent is less than 1, so that slope effects are large for gentle slopes and decline, as slopes get steeper. Megahan and Ketcheson (1996) found that sediment travel distances from road cross drains in the Idaho Batholith are proportional to slope gradient (in percent) raised to the 0.5 power.

Megahan and Ketcheson (1996) and Ketcheson and Megahan (1996) present equations for estimating sediment travel distance below road fills (non-channelized flow) and cross drains (channelized flow) that incorporate sediment volume, obstructions, slope angle, and source area as significant explanatory variables. Slope is a significant predictor of distance, and it is not unreasonable to adjust an RCA width to slope when lacking other intensive site-variable information. At slopes greater than 50 percent, other screening tools that incorporate landslide prone hazards are needed (refer to the Guidelines for Management on Landslide and Landslide Prone Areas in this Appendix).

The strongest single variable affecting sediment travel distance from soil disturbing activities is the volume of material displaced, or delivered to a point on a slope from a culvert, drain, etc. Over 78 percent of the variance in sediment travel distance is explained by volume in the culvert model (channelized flow) of Megahan and Ketcheson (1996).

They suggest that, except on steep slopes, RCAs be designed to protect other riparian functions will generally control sediments to the degree that they can be controlled by riparian vegetation. It is essential, however, that riparian protection be complemented with practices for minimizing sediment contributions from outside the riparian area, particularly those from roads and associated drainage structures, where large quantities of sediment are often produced. In addition, activities within the RCAs that disturb or compact soils, destroy organic litter, remove large down wood, or otherwise reduce the effectiveness of RCAs as sediment filters should be avoided.

Nutrients and Other Dissolved Materials (excerpted from Spence et al. 1996)
Riparian vegetation takes up nutrients and other dissolved materials as they are transported through the riparian zone by surface or near-surface water movement. However, the relationship between RCA width and filtering capacity is less well understood than other riparian functions and ecological processes. Those studies that have been published indicate substantial variability in the effectiveness of RCAs in controlling nutrient inputs. Identifying an appropriate RCA width that can function as a filter for nutrients and other dissolved materials depends on the specific type and intensity of land use, type of vegetation, quantity of organic litter, infiltration rate of soils, slopes, and other site-specific characteristics.
Because of the variability observed in the effectiveness of RCAs in controlling input of nutrients and other dissolved materials, it is difficult to recommend specific criteria for this function. Spence et al. (1996) suggest that for most forestlands, RCAs designed to protect other riparian functions (e.g., LWD recruitment, shading) are probably adequate for controlling nutrient inputs to the degree that such increases can be controlled by RCAs. Exceptions may occur when fertilizer or other chemical applications result in high concentrations of nutrients in surface runoff.

RCA widths for nutrient and pollution control on rangelands should be tailored to specific site conditions, including slope, degree of soil compaction, vegetation characteristics, and intensity of land use. In many instances, RCA widths designed to protect LWD recruitment and shading may be adequate to prevent excessive nutrient or pollution concentrations. However, where land use activity is especially intense, RCAs for protecting nutrient and pollutant inputs may need to be wider than those designed to protect other riparian functions and ecological processes, particularly when land-use activities may exacerbate existing water quality problems.

Riparian Microclimate and Productivity (excerpted from Spence et al. 1996)
Changes in micro-climatic conditions within the riparian zone resulting from removal of adjacent vegetation can influence a variety of riparian functions and ecological processes that may affect the long-term integrity of riparian ecosystems. However, the relationship between RCA width and riparian

microclimate has not been documented in the literature. FEMAT (1993) and Spence et al. (1996) suggest using the generalized curves in FEMAT 1993, relating protection of microclimatic variables relative to distance from stand edges into forests.

Wildlife Habitat (excerpted from Spence et al. 1996)
The importance of riparian areas to many wildlife species is well documented. However, generic recommendations for riparian RCAs to protect wildlife are not justifiable because each species has unique habitat requirements. Some terrestrial and aquatic plant and animal communities rely on the forest and shrubs adjacent to streams and wetlands for all or parts of their life cycles. Animals such as beavers, otters, dippers, and some amphibians are obligate stream and riparian vegetation dependent organisms. Other bird and mammal species and many bat species need the RCAs at crucial life history periods or seasonally for feeding or breeding. Wildlife has a disproportionally high use of riparian areas and streamside forests compared with the overall landscape. RCAs provide habitat needs such as water; cover; food; plant community structure, composition, and diversity; increased humidity; high edge-to-area ratios; and migration routes. When identifying RCAs it is important to also consider the needs of wildlife species.

Windthrow (excerpted from Spence et al. 1996)
Trees within RCAs that are immediately adjacent to clearcuts have a greater tendency to topple during windstorms than trees in undisturbed forests. Extensive blowdown can potentially affect aquatic ecosystems in a number of ways, both positive and negative. In stream systems that lack wood because of past management practices, blowdown may immediately benefit salmonids by providing structure to the channel. Over the long term, however, blowdown of smaller trees may hinder the recruitment of large wood pieces that are key to maintaining channel stability and that provide habitats for vegetation and wildlife within the riparian zone. In addition, soil exposed at the root wads of fallen trees may be transported to the stream channel, increasing sedimentation. Other riparian functions, including shading, bank stabilization, and maintenance of riparian microclimates may also be affected.

Importance of Small Streams
Small streams are more affected by hillslope activities than are larger streams because there are more smaller than larger streams within watersheds (actual area and extent); smaller channels respond more quickly to changes in hydrologic and sediment regimes; and streamside vegetation is a more dominant factor in terms of woody debris inputs and leaf litter and shading. Small perennial and intermittent non-fish-bearing streams are especially important in routing water, sediment, and nutrients to downstream fish habitats.

Channelized flow from intermittent and small streams into fish-bearing streams is a primary source of sediment in mountainous regions. In steep, highly dissected areas, intermittent streams can move large amounts of sediment hundreds of meters, through RCAs, and into fish-bearing streams. In-channel sediment flows are limited primarily by the amount and frequency of flow and by the storage capacity of the channel. Flows in forested, intermittent streams are generally insufficient to move the average-sized wood piece, allowing large wood to accumulate in small channels. These accumulations increase the channel storage capacity and reduce the likelihood of normal flows moving sediment downstream.

Additional Considerations
The publication *Riparian Reserve Evaluation Techniques and Synthesis* (USDA Forest Service 1997) provides an optional toolbox of analysis methods and techniques that addresses the physical and biological elements that are necessary to delineate appropriate widths and appropriate and inappropriate management activities within or that may effect riparian functions and ecological processes. Additional literary references to consider when delineating RCAs are the following:

1) Quigley and Arbelbide (1997) An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins, Volume III (PNW-GTR-405, 1997); An Ecosystem Approach to Salmonid Conservation (NMFS TR-4501-96-6057, 1996);

2) Naiman et al. (2000) Riparian Ecology and Management in the Pacific Coastal Rain Forest Bioscience November 2000 Vol. 50 No. 11, pages 996-1011

3) Megahan and Hornbeck (2000) Lessons Learned in Watershed Management: A Retrospective View USDA Forest Service Proceedings Rocky Mountain Research Station – P – 13. 2000

4) Spence et al. (1996) An Ecosystem Approach to Salmonid Conservation December 1996 TR-4501-96-6057

5) USDA Forest Service (1997) Riparian Reserve Evaluation Techniques and Synthesis, Supplement to Section II of Ecosystem Analysis at the Watershed Scale: Federal Guide For Watershed Analysis. Version 2.2.

IMPLEMENTATION GUIDE FOR IDENTIFYING AND MANAGING LANDSLIDE AND LANDSLIDE PRONE AREAS

Introduction

This implementation guide describes the basis for Forest-wide landslide-prone (LSP) area management direction and provides a multi-scale step down approach to implementing management actions on LSP areas.

This implementation guide describes the basis for Forest-wide LSP area management direction and provides information for how to implement management actions on LSP areas.

Landslides are a part of a watershed's natural disturbance regime and contribute to proper watershed function and development of aquatic habitat by providing coarse sediment and LWD. The potential for accelerating landslides above some natural level should be minimized (Frissel et al. 1996). This can be accomplished in three ways: (1) Delineating LSP areas with both coarse and fine filters; (2) Developing Forest-wide management direction to properly manage these sensitive areas; and (3) Mitigating management practices based on the relative landslide hazard and associated risk(s).

Identification and development of Forest-wide management direction for LSP areas is a relatively recent requirement for implementing land management actions on the Forest. Development of the Forest-wide management direction incorporated the intent of reducing the threats associated with management actions that might initiate landslides. This Forest-wide direction is similar to the direction identified in recent documents including: Pacfish EA (USDA FS and USDI BLM 1994); INFISH EA (USDA Forest Service 1995); Steelhead Biological Opinion (US Dept of Commerce NMFS 1998); and Bull Trout Biological Opinion (USDI FWS 1998). Chapter III in this Forest Plan has goals, objectives, standards, and guidelines related to identification and management of landslide and LSP areas.

Background

The process for determining LSP areas needs to be consistent, based on the most recent science and literature, applicable from mid-scale to the site or project level, at both broad scale and fine scale, and reproducible over large geographic areas. The use of a physically based model to provide a practical alternative to using riparian buffers for the purpose of protecting potentially unstable ground was identified by Tang and Montgomery (1995). The process needed to be based in a GIS environment in order to be reproducible over large geographic areas. Ground slope and contributing drainage area obtained from Digital Elevation Model (DEM) in the GIS would also be important. Personnel at the Rocky Mountain Research Station (RMRS) in Boise, Idaho recommended several computer models (some of which are GIS based) for determining land slope stability. These models included: LISA, SHALSTAB, and SINMAP. The SINMAP (Stability INdex MAPping) model was found to be to best meet the needs identified above after testing with assistance from Boise State University, Utah State University, and RMRS personnel (Dixon et al. 1999). SINMAP is a terrain stability mapping tool that has application in areas that experience shallow translational landsliding, the dominate type of landslide found within the Forest (Megahan et al.1978, Clayton 1983, Dixon 2001).

SINMAP Model

LSP maps/coverages were developed using the SINMAP model (Pack et al. 1997) and a relatively large database of actual landslides to assist in the calibration of the model. The SINMAP model has accurately delineated the pattern of landsliding in British Columbia (Pack et al. 1997) and meets the intent of the 1998 Steelhead BO that states, "To define landslide prone areas, utilize methods described by Prellwitz et al. (1994), or use at least an equivalent peer reviewed methodology with at least a 90 percent probability of identifying landslide prone slopes." SINMAP is also mentioned as a tool for analyzing shallow landsliding potential in the recent publication, *Roads Analysis: Informing Decisions About Managing The National Forest Transportation System* (USDA Forest Service 1999).

SINMAP is an Arc View extension that implements the computation and mapping of a slope stability index based upon geographic information, primarily digital elevation data. SINMAP has its theoretical basis in the infinite plane slope stability model with wetness obtained from a topographically based steady state model of hydrology. The SINMAP model uses landslide initiation points (identified in the field or through aerial photos) in GIS and three input parameters (T/R; C'; and Phi) to calibrate the model. The term T/R is the ratio of transmissivity to the effective recharge rate of the storm being modeled. T/R may be abstractly thought of as the slope distance required for soil saturation on a straight slope. The term C' is dimensionless cohesion of soil. The term is a combination of root and soil cohesion divided by soil depth. The term Phi is the internal angle of friction of the soil. The SINMAP model uses uniform probability distributions of the input parameters using a lower and upper limit. This approach reflects the uncertainty associated with estimating parameters in terrain stability mapping (Prellwitz et al 1994, Dixon et al. 1999).

DEM methods are used to obtain slope and catchment areas for each individual pixel mapped. Input parameters are allowed to be uncertain following uniform distributions between specified limits. Input parameters are adjusted and calibrated for geographic "calibration regions" based upon landform, soil, vegetation, climatic, and/or geologic data. The calibration involves an interactive visual calibration that adjusts parameters while referring to observed landslides (mapped in GIS). The calibration involves adjustment of parameters so that the stability map "captures" a high proportion of observed landslides in regions with low stability index, while minimizing the extent of the low stability regions. The SINMAP modeling produces a stability index for each pixel of the DEM analyzed. The pixels are then grouped into four relative hazard classes (stable, low, moderate, and high) based on their calculated stability index.

Step-Down Implementation Process

This guide is not intended to be a decision-making process but will assist in informing land managers in making decisions related to management of LSP areas and potential hazards and risks to other resources. It is to be used in conjunction with the Forest-wide management direction associated with landslide and LSP areas (see Chapter III of the revised Forest Plan). A step-down process for using information at multiple scales to aid in decision-making will be implemented using a coarse filter and fine filter approach to ensure that decisions on management actions will be informed.

The coarse-filter programmatic LSP hazard coverage can be used qualitatively to make relative comparisons between areas, and to identify those that should be targeted for additional fine-filter verification associated with proposed management actions. The SINMAP model and the associated Forest-wide programmatic coarse-scale LSP maps (as well as other appropriate methodologies) are to be used by investigators who have some knowledge and experience concerning landslide behavior and geotechnical properties of soils. The model requires professional judgment and common sense (in the field and office), both in developing input coefficients and interpreting the results. It does not give a unique "right" answer. This is a tool to help understand slope stability processes; to quantify/qualify observations and judgments; and to document and communicate those observations and judgments to land managers. The computer modeling should be used to focus on specific areas of concern for on-the-ground field verification of LSP areas.

SINMAP or other appropriate methodologies do not provide a complete risk analysis; the risk or consequence of potential failures needs to be evaluated by the user. The user may want to assess the potential damage to aquatic habitat and soil productivity, or to roads and structures, or the potential for injury or loss of life resulting from landslides. As an example, two slopes may have the same estimated LSP hazard. However, if an anadromous spawning area or bridge lies below one of the slopes and not the other, the risks associated with the failure of the first slope are much greater than are those associated with the other slope. This guidebook is not intended to serve as a comprehensive risk analysis tool.

Coarse Filter Process and Intended Use

The LSP coarse filter has been completed and the results are in the form of a Forest-wide GIS coverage that has rated each 30-meter topographic cell a relative LSP hazard rating (stable, low, moderate and high) (Dixon et al. 1999). This coarse-filter modeling effort results in a relatively conservative estimate and identifies where additional field verification (fine filter) is warranted for proposed management actions.

This coarse-filter process utilized numerous landslide initiation points and a stratification of the Forest's land base (approximately 2-3 million acres) using groupings of landtype associations. The relatively rich landslide inventory database on the Forest, combined with 15 groupings of landtype associations to assist in the calibration of the SINMAP model, enabled a relatively accurate identification of LSP areas for the coarse filter.

Additional landslide hazard modeling at finer scales (project or watershed areas) allows for more detailed analysis based on site-specific parameters. Locally based landslide inventories are important for developing site-specific parameters for modeling, as well as criteria for field verification of LSP areas.

Accurate landslide locations in GIS greatly assist in the calibration of the SINMAP model. Inventoried landslide data gathered on the ground--such as ground slope, soil depth, soil texture, vegetation, slope shape, slope position, and contributing area--provide valuable information for both modeling and field verification of LSP areas. The accuracy in identification of LSP areas and their relative hazards will increase as more data is available through fine-filter analysis. When considering the percentage of land area involved in landslides, we must realize that LSP areas may actually occur on a relatively small portion of the landscape. Published landslide inventories indicate values on the order of 0.5 to 15 percent of the area inventoried (Ice 1985). As more fine-filter data (field verification and data from landslide inventories) become available, the certainty in identifying LSP areas should increase.

The following Forest-wide management direction based on the coarse and fine filters applies to both Forest-wide and project-level analysis:

SWRA Standard 12 - Site-specific analysis or field verification of broad-scale landslide-prone models shall be conducted in representative areas that are identified as landslide prone during site/project-scale analysis involving proposed management actions that may alter soil-hydrologic processes. Based on the analysis findings, design management actions to avoid the potential for triggering landslides. Refer to the *Implementation Guide for Management on Landslide and Landslide Prone Areas"* located in Appendix B to help determine compliance with this standard.

SWRA Guideline 3 - Where proposed management actions may alter soil-hydrologic processes, representative sample of landslides and landslide-prone areas should be field-verified to identify and interpret controlling and contributing factors of slope stability. Integrate the resulting information with supporting data to provide a final stability assessment and identification of appropriate land management actions in landslide and landslide-prone areas. Refer to the *Implementation Guide for Management on Landslide and Landslide Prone Areas*, located in Appendix B.

SWRA Guideline 4 - General Field Verification Procedures for Landslide and Landslide-Prone Areas: Six major groups of known characteristics should be investigated to supply information adequate to characterize unstable conditions. These are:

- Landform
- Overburden
- Geological Processes on the Hillslope
- Bedrock Lithology and Structure
- Hydrology
- Vegetation

Refer to the *Implementation Guide for Management on Landslide and Landslide Prone Areas*, located in Appendix B.

Fine-Filter Process and Intended Use

Verification through a combination of field work, aerial photograph analysis, and further SINMAP modeling, will reclassify the relative slope stability hazard rating for a given area. This reclassification increases the accuracy/probability of identifying LSP hazards and assists in the development of management practices appropriate for the site, thereby greatly reducing the threats of negative effects to other resources.

The fine-filter process is intended for field verification and reclassification of the coarse filter LSP area coverage. Field evaluation of slope stability is warranted along road corridors, for timber sale areas and associated harvest units, and other site-specific management actions with the likelihood of modifying landslide processes. Proper management of LSP areas is not based solely on the effects to fish habitat but also effects to long-term soil productivity, water quality, and watershed function, and identifying risks to life and property.

Measures for Avoidance and Prevention of Landslides on LSP Areas

Measures for avoidance and prevention of landslides associated with management actions on LSP areas are improved through fine-filter verification. Recognition and avoidance of high-risk LSP areas are the most effective and cost-efficient methods in implementing management actions. On extreme slopes, abandonment of the area may be the best environmental and economic solution. In most instances within the Forest, the LSP portion of a slope covers only a small area. Megahan et al. (1978) found that, of more than 1,400 landslides inventoried, 90 percent occurred in drainages of four hectares (about 10 acres) or less. Careful field verification can locate the LSP areas. Often they may be easily avoided during road location or deleted from the timber harvest units. Slight changes in the road location or changes in road grade are often adequate to bypass the LSP area. Chapters 3 and 4 of the publication, *A Guide for Management of Landslide-Prone Terrain in the Pacific Northwest* (Chatwin et al. 1994) provide good assistance in both field-identifying landslide prone areas and developing site-specific management practices and mitigation on LSP areas.

In order to avoid or prevent landslides, it is important to understand what disturbances (management-related or natural) have a greater potential to initiate landslides. Road construction is the main destabilizing activity related to forest management actions. Megahan et al. (1978) found that 58 percent of management-related landslides were related solely to roads, while forest vegetation removal accounted for only 9 percent of landslides. Roads in combination with logging or wildfire accounted for 88 percent of all management-related landslides. Gucinski et al. (2001) identified several studies where landslide erosion from roads was one to several orders of magnitude higher than forest vegetation management.

The effects of wildfire may also greatly influence occurrence of landslides. Shaub (2001) found that, of 246 landslides inventoried in the South Fork Payette River watershed near Lowman, Idaho, occurrences of landslides within the burned area of the 1989 Lowman wildfire was 2.5 times greater than in the unburned area. None of these landslides was attributed to past or current management actions. Megahan et al. (1978) postulates that careful land use decisions, considering the amount and nature of disturbance and various site factors, can substantially reduce the occurrence of landslides and the magnitude of their effects.

Fine-filter LSP areas are more accurately identified, allowing for increased accuracy and probability of identifying LSP hazards and assisting in the development of management practices appropriate for the site. Depending on the proposed management action and the associated relative LSP rating, a variety of management practices may be developed. These practices vary based on the type and potential effect of management action and the relative landslide prone hazard in which actions will occur. In general, land managers should consider the following contributing factors when designing and implementing management actions that might initiate or contribute to landslides.

- Altering vegetation can affect landsliding potential. Large blocks of tree mortality caused by wildfire, insects and disease, or logging can decrease evapotranspiration and raise ground water tables (T/R). The increased ground water can add to the slope instability on LSP areas during storm events that may initiate landsliding.

- Rooting strength of vegetation in LSP areas is a major factor adding stability to the slopes. Altering the vegetation by management practices such as timber harvest and controlled burning has the potential to affect rooting strength (C’). Wildfires also alter vegetation (sometimes greatly with uncharacteristic wildfires), causing tree mortality and affecting rooting strength. Trees provide the greatest amount of rooting strength on forested slopes. Generally the larger trees have a more developed root system and provide more stability to the slopes. Tree species such as ponderosa pine that have a deep tap root provide deeper rooting strength and more stability than similar size species like Douglas-fir that do not have a deep tap root. Burroughs and Thomas (1977) indicates that since a relatively high percentage of mass failures (landslides) occur on areas burned over by wildfires compared with undisturbed forests, that declining root strength following death of trees is an important factor in mass failure of shallow soils on steep slopes in the Idaho Batholith.

- Soil depth influences landslide potential. Deeper soils tend to slide on less steep of a slope than shallow soils. Soil properties affect landslide potential. Rocky soils with angular rock fragments have a higher internal angle of friction than soils with only minor amounts of rock fragments. The soils with a higher internal angle of friction will be more stable than soils with low internal angle of friction on the same slope gradient. Soils with coarse angular sands have a higher internal angle of friction than soils composed of fine sands. For example, oversteepened granitic canyonlands with shallow non-cohesive soils are more susceptible to landslides than maturely dissected mountain slopes with deep loamy skeletal soils.

- The water collection area above a potential landslide prone area has a major influence on landslide potential. Areas where water tends to collect--such as the head of ephemeral draws, bowl shaped areas, and hollows--tend to have high groundwater levels during storm events (T/R) that initiate landslides. Soils at or near saturation tend to have less strength and are more prone to landslides than soils with lower groundwater levels. For example, 3 feet of soil at the head of and ephemeral draw on a 60 percent slope at or near saturation would be much more prone to landslides than 3 feet of soil on a 60 percent slope where the groundwater table is lower.

- Roads have the potential to affect landsliding in several ways. Roads alter the natural ground slope with cuts and fills. Road cuts may destabilize slopes above the cuts by removing material that provided stability to the slope above. Road fills place additional material on slopes that tends to load the slope below the road, increasing the risk of mass failures. Road drainage features such as dips and culverts tend to collect water and concentrate it on slopes below. The additional water can add instability to the slopes. Care should be taken with road drainage so that water is not collected and concentrated on LSP areas below roads.

Other risks should be considered when proposing practices on LSP areas. One major factor is what lies within the path of the landslide that it could potentially affect. Landslides that initiate in the heads of ephemeral draws often trigger channel-scouring debris torrents that can disturb a larger area within a stream channel than the landslide itself. Landslides and their associated debris torrents can and have blocked highways, damaged homes, and other facilities. Deeply scoured channels can take several decades to recover, and are persistent sediment sources due to the raw and oversteepened banks. This sediment may have a lasting effect on water quality and fisheries habitat. Existing and proposed facilities should be located in areas away from the mouths of steep-gradient streams and draws where there is potential for damaging debris torrents initiated by landsliding.

Methods for avoidance and preventing landslides may include but are not limited to:

- Standard Practices – (In Stable and Low Hazard Areas) No special restrictions on management actions are needed as long as the actions are in compliance with other Forest-wide or management area direction.

- Limited Practices – (In Moderate Hazard Areas with Low to Moderate Relative Risk) Management actions are designed with review and guidance of appropriate resource specialists. Limited practices may include but are not limited to: reducing yield or basal area removal of forested vegetation, increased rotation lengths, selective harvest with full suspension yarding, relocating existing or proposed road alignment, improving road drainage design, etc.

- Restricted Practices – (In High Hazard or Moderate Hazard Areas with High Relative Risks) Management actions are severely restricted or eliminated so as to minimize initiation of landslides and effects to other resources.

Chapter 2 in the publication, *A Guide for Management of Landslide-Prone Terrain in the Pacific Northwest* (Chatwin et al. 1994) has a good discussion and field evaluation forms that may serve as a good reference to assist in completing fine-scale field verification.

AQUATIC CONSERVATION STRATEGY

Introduction

The Aquatic Conservation Strategy (ACS) strategy provides direction to maintain and restore characteristics of healthy, functioning watersheds, riparian areas, and associated fish habitats. How these components are applied at the subwatershed and site-specific levels will affect the types and outcomes of management actions and will therefore be an overriding factor that influences potential effects for SWRA resources.

The intent of this section is to examine the eight components of the ACS and the level of protection to demonstrate how they address the threats associated with the factors of decline and provide for recovery and restoration of listed species, their habitat, and SWRA resources. For further detailed description of the eight ACS components refer to Section III.E in the Biological Assessment for the SWIE Revision.

The Forest Plans were developed to provide direction (i.e., goals, objectives, standards and guidelines) for broad classes of management activities and land and water management practices that may affect SWRA resources. Embedded within the ACS, Forest Plans provide policy guidance and requirements. The ACS is a long-term strategy to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within lands administered by this National Forest. It is a refinement and furtherance of approaches outlined in the ICBEMP Implementation Strategy and the USFWS and NMFS 1998 Biological Opinions.

The eight ACS components are identified below. Each component is discussed in detail, including its role in addressing reduction of threats associated with factors of decline and/or its role in a comprehensive recovery and restoration strategy for listed fish species and their habitats. Any of these components has the potential to influence any of the factors of decline or the recovery/restoration strategy.

1. Goals to Maintain and Restore SWRA Resources
2. Watershed Condition Indicators for SWRA Resources
3. Delineation of Riparian Conservation Areas (RCAs)
4. Objectives, Standards, and Guidelines for Management of SWRA Resources, including RCAs
5. Determination of Priority Subwatersheds within Subbasins

6. Multi-Scale Analyses of Subbasins and Subwatersheds
7. Determination of the Appropriate Type of Subwatershed Restoration and Prioritization
8. Monitoring and Adaptive Management Provisions

The ACS provides a scientific basis for protecting aquatic ecosystems; providing for a comprehensive short and long-term recovery of listed fish species; restoration of aquatic habitats and surrounding terrestrial uplands; de-listing of water quality impaired water bodies; and planning for sustainable resource management. In essence, this strategy integrates many of the goals and objectives of both the ESA and the Clean Water Act.

The eight components of the ACS are designed to work in concert to maintain and restore the productivity and resilience of watersheds and their associated aquatic systems. The following discussion reviews each of the eight ACS components and how they reduce threats and or assist in the recovery/restoration of listed fish species, their habitats, and SWRA resources.

ACS Component 1. Goals To Maintain And Restore SWRA Resources

ACS Component 1 serves to reduce the threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species and their habitats. The ACS goals, objectives, and management actions are integrated with the other resource and social-economic components of the ecosystem. Ecosystems are healthy and sustainable when their intertwined components and processes are functioning properly, in the context of the desires and needs of society. The ACS components and processes are woven together by the thread of succession/disturbance regimes (e.g., wildfire, landslides, floods, insects and disease) and ecological processes (e.g., flows and cycles of energy, nutrients, and water). Intact succession/disturbance regimes provide for aquatic and terrestrial habitats, intact hydrologic processes, and the continuous and predictable flow of products and land uses. These landscape considerations and their dynamics are the cornerstone of the combined Forest-wide SWRA goals.

The goals to maintain and restore SWRA resources establish a vision of management direction that reduces threats associated with the factors of decline with the expectation that this will promote the characteristics of healthy, functioning watersheds, riparian areas, and associated fish habitats. Because the quality of water and fish habitat in aquatic systems is inseparably related to the integrity of upland and riparian areas within the subwatersheds, the goals encompass both aquatic and terrestrial processes and functions.

The long-term ACS and associated goals to maintain and restore SWRA resources greatly reduce threats and risks of negative effects to listed fish species, resident fish, and water quality conditions in several ways. Primarily, the goals provide the basis for management direction that will be applied to all activities that can affect SWRA and related resources, including listed fish species and their habitats. Other ways that the goals reduce threats and contribute to recovery/restoration include:

- Goals to restore and maintain SWRA resources have been coordinated and integrated with the goals of other resource areas.

- The predicted production of goods and services for key resources has been adjusted to show a more realistic potential for achieving resource goals. For example, RCAs and high landslide prone areas were removed from the suited timber base to indicate that these areas will not be used as a source of predictable timber supply.

- Forest vegetation management goals and their associated management actions (mechanical harvest, fire use and road-related activities) were analyzed using the Cumulative Watershed Effects (Menning et al. 1996) approach for each subbasin to determine their feasibility and compatibility with aquatic resources and water quality beneficial uses.

- Goals identify the destination toward which objectives move baseline conditions during the life of the planning period. There are numerous Forest-wide and Management Area riparian-related goals with associated objectives that spatially and temporally identify restoration prioritization based on the long- and short-term recovery needs of listed fish species and the de-listing of water quality impaired water bodies.

- Goals to restore and maintain SWRA resources were developed with an interdisciplinary team approach to make them understandable, consistent, and capable of being implemented. This approach will further reduce the potential for negative effects from misinterpretation in the planning and implementation of management actions.

- Goals have been developed to achieve the desired conditions described in the TEPC Species and SWRA Resources sections in Chapter III of the Forest Plan, and in the Desired Conditions Common to All Resources section. These desired conditions, in general, envision a landscape that maintains and restores productive and sustainable ecosystems, of which SWRA and TEPC resources are inextricably linked.

ACS Component 2. Watershed Condition Indicators For SWRA Resources

ACS Component 2 serves to reduce the threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species and their habitats WCIs represent diagnostic indicators of the health and trend of watersheds and associated aquatic systems. The WCIs identify various biological and physical components of aquatic systems and associated terrestrial uplands that influence riparian functions and ecological processes. The WCIs are organized into eight Pathways that represent the processes or mechanisms by which management actions can potentially affect watersheds, listed fish species, native and desired non-native fish species and their habitats, and beneficial uses.

The evaluation of WCIs provides a consistent and logical line of reasoning to recognize when, where, and why adverse, beneficial, or no effects may occur to related resources. WCIs are not independent from other components of the ACS but provide a starting point to describe the current and desired conditions for uplands, riparian areas, water quality, and aquatic habitat.

Evaluation procedures consider the suite of WCIs that are likely to be affected by proposed management actions, not just effects to any individual WCI. WCIs are described in terms of how they are functioning (Functioning Appropriately, At Risk, or At Unacceptable Risk), with Functioning Appropriately representing the range of desired conditions to strive toward for each WCI. The WCIs incorporate riparian functions and ecological processes of the entire watershed.

The step-down implementation process is outlined later in this Appendix. This process will assist land managers with making informed decisions by determining the relevant WCIs that should be considered when proposed management actions may affect the habitat of listed fish species; inland native; or desired non-native fish; or water quality beneficial use status.

The Matrix of Pathways and Watershed Condition Indicators is a combined matrix based upon individual USFWS and NMFS Matrices. It assesses potential threats of management actions. The use of this matrix can greatly reduce the risk of negative effects to listed fish species, resident fish and water quality conditions by providing:

- A process to identify how management actions may potentially influence the condition and trend of SWRA resources, including native and desired non-native fish species and their habitats, and beneficial uses;
- A decision framework to assist decision makers in ensuring that management actions will not retard or prevent attainment of properly functioning SWRA desired conditions;
- A tool to assist in making ESA determinations of effects to listed fish species important to assessing ESA compliance;
- A clear and comprehensive set of terms/definitions and Forest-wide standards and guidelines to help prevent degradation of areas that currently surpass the WCIs range of desired conditions, are within the range of, and are currently below the range of WCIs;
- A benchmark by which changes to landscape conditions through management activities can be measured over time;
- Criteria against which attainment or progress toward attainment of multiple goals, standards and guidelines in Chapter III of the Forest Plans can be directly or indirectly measured;
- Criteria for different scales of evaluation, important for assessing effects of project-level management in context of multiple scales.

ACS Component 3. Riparian Conservation Areas – Delineation

ACS Component 3 serves to reduce the threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species and their habitats. Aquatic and riparian systems are easily affected by land management activities within RCAs and on the surrounding terrestrial uplands. RCAs contribute to maintaining the integrity of aquatic ecosystems by (1) influencing the delivery of coarse sediment, organic matter and woody debris to streams; (2) providing root strength for channel stability; (3) shading the stream; and (4) protecting water quality. Additional processes and functions provided by RCAs can include wildlife habitat and riparian microclimate and productivity.

Because of the importance of riparian systems on the integrity of aquatic ecosystems that support listed fish habitat, appropriate delineation of RCAs is needed. Recent discoveries about the structure and dynamics of riparian zones have extended the scope of understanding about this portion of the landscape and have important management implications for streams, riparian areas, and adjacent uplands (Spence et al. 1996, Quigley and Arbelbide 1997). The process and methodology for RCA delineation is described in detail earlier in this Appendix.

Implementation of the "Guidance for Delineation and Management of Riparian Conservation Areas" in this Appendix would substantially reduce threats associated with the design and implementation of management actions. This implementation guide provides a consistent and thorough procedure in the delineation of appropriate RCAs across the Forest. The reduction of threats is based on the following:

- The range of options that may be used to delineate an RCA allows land managers to determine the level of analysis that best suits the needs of a project based on potential effects, baseline conditions, management direction, and issues. Regardless of the option chosen, the RCA delineation provides for consideration of riparian functions and ecological processes.

- The integration of Forest-wide management direction and guidance for delineation of RCAs defines the type and levels of management actions that are suitable within or adjacent to RCAs.

- The effectiveness of delineating an appropriate RCA provides decision-makers with the information necessary for sound decisions regarding management activities within a subwatershed. An understanding of riparian functions and ecological processes, and the means by which actions may affect them, allows decision makers the opportunity to design activities to maintain or restore listed fish species, their habitats, and other SWRA resources.

- RCA delineation makes use of information obtained through multi-scale analysis (ACS Components 6 and 7) to determine the appropriate scale for assessing the different riparian functions and ecological processes that need to be addressed.

- Delineation of RCAs establishes a network of refugia that promotes the conservation of listed fish species while preserving and restoring riparian function and ecological processes;

- RCA delineation will use data collected at mid-, fine-, or project scales to ensure that site-specific riparian function and ecological processes are maintained or restored.

ACS Component 4. Objectives, Standards, And Guidelines For Management Of SWRA Resources, Including RCAs

ACS Component 4 serves to reduce threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species, their habitats, and SWRA resources. Management direction within Chapter III in the Forest Plan includes Forest-wide direction, Management Area direction, and Management Prescription Category direction. Together this direction provides the operating sideboards for implementation of management activities designed to further the achievement of the ACS components as well as other resource goals described in the Forest Plan. Specific objectives designed to achieve Forest-wide management goals are also included in this ACS component.

The development of the long-term ACS and associated objectives, standards, and guidelines to maintain and restore SWRA resources primarily reduces threats and the risks of negative effects to listed fish species, resident fish, and water quality conditions by providing protection necessary to conserve listed fish species and water quality, and direction to maintain or restore priority subwatersheds. The reduction in threats and risks of negative effects is accomplished under this ACS component in a variety of ways:

- The development of the objectives, standards and guidelines to restore and maintain SWRA and other related resources was coordinated and integrated with direction for other resource areas to ensure compatibility and consistency in implementation.

- Forest vegetation management direction and associated management actions (mechanical harvest, fire use and road-related activities) were analyzed using a Cumulative Watershed Effects methodology (adapted from Menning et al. 1996) for each subbasin to determine feasibility and compatibility with the values of aquatic resources and water quality beneficial uses.

- Objectives have been designed that will achieve goals both spatially and temporally, address resource concerns and needs, and move existing conditions toward desired conditions over the life of the planning period.

- The development of objectives, standards, and guidelines to restore and maintain SWRA resources was done through coordination between a Level 1 consultation team and an interdisciplinary team to make them clearly understood, and ensure direction could be implemented when integrated with other resource objectives. This integration reduces the likelihood of delays in movement toward achieving goals due to incompatible direction.

ACS Component 5. Priority Subwatersheds Within Subbasins

Note: The results of ACS Component 5 are a result of the multi-scale PFC assessment and analysis in ACS component 6 and its fine-tuning in ACS Component 7. Therefore, it is important to review all three ACS components (5, 6, and 7) to gain a complete understanding of the effects of these components.

ACS Component 5 serves to reduce the threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species, their habitats, and SWRA resources. Priority subwatersheds have been identified that provide a pattern of protection and restoration across the Forest for the recovery of threatened and endangered fish species, the de-listing of water quality impaired water bodies, and the restoration and maintenance of SWRA resources. The identification and management of these priority subwatersheds are designed to complement other recovery/restoration plans and build on actions already taking place to recover these species and de-list impaired water bodies.

The process used to identify ACS priority subwatersheds for the ACS is described in Section III(E)(6) of the Biological Assessment for the SWIE Revision. ACS priority subwatersheds have the highest priority for restoration, monitoring, and future multi-scale analysis. In addition, each ACS priority subwatershed is identified in its respective management area direction. The management areas have objectives for the priority and appropriate type of restoration/conservation. Additional management area standards and guidelines further reduce potential impacts associated with other resource management actions. ACS priority subwatersheds reduce threats and contribute to recovery or restoration through the following:

- Management area direction applied to ACS priority subwatersheds reduces site-specific threats to aquatic and watershed values from management actions;

- Management Area direction recognizes the ACS priority subwatersheds as meriting specific management consideration of their aquatic and watershed values during the planning and implementation of management actions.

- Specific management area objectives identify and prioritize the need for restoration or conservation;

- Forest-wide management direction requires that the Watershed and Aquatic Recovery Strategy be updated every 2 years, thus contributing to the effectiveness of the recovery plans for listed fish species and de-listing of water quality impaired water bodies.

- The ACS priority subwatershed designation increases the chance to successfully obtain funding and implement restoration by providing out-year project opportunities and a ready source of needed projects that are part of a mid-scale recovery strategy;

- ACS priority subwatersheds are identified for all subbasins regardless of whether listed fish species occur within them. This allows for appropriate conservation of all resident fisheries and de-listing of water quality impaired water bodies.

- ACS priority subwatersheds are identified for each subbasin and provide a "blue print" of short-term recovery while identifying those subwatersheds important for the long-term recovery of the listed fish species.

- The ACS provides a long-term focus for conservation and restoration of high quality strongholds of listed fish species habitat and restoration prioritization of subwatersheds required for further expansion and re-colonization of fish species to adjacent subwatersheds.

ACS Component 6. Multi-Scale PFC Assessment Of Subbasins And Subwatersheds

ACS Component 6 contributes to the comprehensive recovery and restoration strategy for listed fish species, their habitats, and other SWRA resources. The Forest completed a Properly Functioning Condition (PFC) assessment that provides a multi-scale context between each subbasin and its subwatersheds, and identifies current and potential population status, habitat condition and restoration needs, and management risks and opportunities to meet broad-scale and mid-scale objectives through subsequent site-specific management actions. This assessment assessed the current condition of the SWRA resources based on the integration of soil-hydrologic function, dynamic stream equilibrium, associated aquatic habitat, status of listed and native fish populations, and other resource conditions (vegetation hazard, road transportation system, unroaded and undesignated low road density areas, wildland urban interface areas, etc.) for the subbasins and their respective subwatersheds.

The multi-scale assessment provides a step-down implementation process that forms the basis for a much bigger picture of effects (direct, indirect, cumulative effects at a programmatic scale) on the sustainability and recovery of listed fish species and de-listing of water quality impaired water bodies. The assessment shows how an individual subwatershed contributes to recovery of a species within a subbasin. As such, the ACS presents an interim recovery strategy until formal recovery plans are issued for listed fish species.

The multi-scale assessment served as the groundwork in the development of the comprehensive ACS that was used in the development of management direction to support the goals, objectives and requirements of the ESA, CWA, and other fish and water quality statutes. The Forest Plan also requires the update of the WARS environmental baseline, the foundation for the multi-scale assessment, every two years with available data and new science findings. These updates ensure an appropriate, comprehensive, and current ACS to assist in the recovery of listed fish species and de-listing of water quality impaired water bodies.

At a subwatershed scale or site-specific project scale the potential for a management action to contribute to conditions that will positively or negatively contribute to the broader-scale goals and objectives can be completed by viewing project level effects in context to the multi-scale assessment completed in support of Forest Plan revision and other broader-scale assessments (e.g., NWPCC Subbasin Assessments, Final Basinwide Salmon Recovery Strategy, and Final Bull Trout Recovery Plans).

The Multi-scale PFC assessment provides a multi-scale context of each subbasin and its respective subwatersheds' baseline and potential status of population and habitat conditions to develop site-specific management actions to make progress towards attainment of ACS goals. This ACS component provides the appropriate scales to ACS components 5, 7, and 8, that prioritize, design, and evaluate management actions needed to move towards ACS goals and the conservation of the listed fish species, their habitats and other SWRA resources. Other ways that the multi-scale PFC assessment contributes to recovery or restoration include:

- The subbasins and associated subwatersheds on the Forest have had consistent and comprehensive multi-scale PFC analyses that have resulted in identification of priority subwatersheds, the appropriate type of approach to subwatershed restoration, and the prioritization of subwatershed restoration.

- The results of the multi-scale assessment have been incorporated into many facets of the Forest Plan such as Forest-wide objectives, standards and guides; Management Area specific objectives that recognize the importance and value of priority subwatersheds; and development of specific Management Area objectives for restoration and recovery.

- Identification of unroaded and undesignated low road density areas and their use in determining the condition of geomorphic, water quality and aquatic integrities for each subwatershed and their importance to recovery and restoration goals;

- Forest-wide management direction requires that the Watershed and Aquatic Recovery Strategy be updated every two years, which will contribute to a more effective recovery plan for survival and recovery of listed fish species and de-listing of water quality impaired water bodies.

- Multi-scale analyses are required or recommended in support of management actions as identified in the following Forest-wide management direction: Roads Analysis identified in the FSM 7700 – Transportation Analysis; FSM 2671.45 - Consultation and Conference; FSH 2509.22 - SOIL AND WATER CONSERVATION PRACTICES FSH (R-1/R-4 AMENDMENT NO. 1) PRACTICE: 11.01 - Determination of Cumulative Watershed Effects:

- Regional and Forest Program Managers can use this information and work with District Program managers to bring the larger picture (subbasin-scale layer) of restoration into consideration when planning watershed-scale and site-scale analyses and projects.

ACS Component 7. Determination Of The Appropriate Type Of Subwatershed Restoration And Prioritization

ACS Component 7 contributes to the comprehensive recovery and restoration strategy for listed fish species and their habitats. Identification of both the appropriate type and prioritization of subwatershed restoration/conservation is integrated into all the ACS components. ACS Component 7 identified the appropriate restoration type and subwatershed restoration prioritization for subwatersheds within their respective subbasins.

Inherent in the classification approach of ACS Component 7 is the identification of active, passive, and conservation restoration opportunities based on the subwatershed's geomorphic integrity (GI), water quality integrity (WQI), aquatic integrity (AI), and vulnerability ratings. Together, these ratings provide the information needed to identify the capacity of the subwatershed to restore itself naturally to a desired condition. The ratings also indicate the acceptable or needed time period for restoration in order to determine the type of approach (restoration or conservation) to be used. The determination of types and priorities of restoration activities incorporated information on the entire subwatershed, including the current status and recovery needs of listed fish species.

This restoration priority rating, in conjunction with the restoration type and overall priority watershed classification, provides the focus for the long-term ACS recovery of listed fish species and TMDL watersheds. The spatial display of this restoration strategy is the WARS Map, on file in the Forest's GIS library.

Recovery and restoration activities are prioritized based on the presence and sensitivity of listed fish species, impaired water bodies, and the capacity for response of the subwatershed's ecosystem processes. This restoration prioritization approach formulates the template for recovery and restoration by:

- Consistently applying the restoration type (conservation, active, or passive) and prioritization for subwatershed restoration to all subwatersheds within their respective subbasins across the Forest,
- Providing an efficient means to promote restoration activities and recovery of listed fish species and de-listing of water quality impaired water bodies;
- Increasing the chance to successfully obtain funding and implement restoration by providing out-year project opportunities and a source of needed projects that are part of a mid-scale recovery strategy;
- Influencing the placement of MPCs within a Management Area's subwatersheds.

ACS Component 8. Monitoring And Adaptive Management Provisions

ACS Component 8 serves to reduce the threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species and their habitats. One of the lessons learned from implementing the original Forest Plan is that it must be dynamic to account for a multitude of issues. The Forest monitoring plan accomplishes five items: (1) it bases the level of monitoring on the commensurate level of management actions; (2) it provides feedback on the effects of activities; (3) it has a mechanism for monitoring accountability and oversight, (4) it evaluates the implementation and effectiveness in the recovery/restoration of listed fish species, their habitats, and other SWRA resources; and (5) it incorporates the monitoring goals identified in the ICBEMP Implementation Strategy and associated MOU.

This plan has a feedback loop that provides management with the information necessary to make appropriate adjustments to individual activities and Forest-wide programs. The feedback loop allows management adjustments as needed to continue moving towards attainment of ACS goals, recovery of listed fish species, restoration of their habitats, and to assist in the delisting of water quality limited waterbodies. If monitoring concludes a specific restoration practice is ineffective or riparian conditions are not being maintained over a number of sites, changes to management practices will be implemented. Those threats that are easily recognized will be dealt with quickly. Monitoring and adaptive management would reduce threats and contribute to recovery or restoration by the following:

- In some cases, low levels of negative effects from either an individual action or aggregate effects from multiple actions may persist until monitoring can alert managers to the need to change management practices or an adjustment in forest plan direction. The adaptive management process will use monitoring results to ensure forest plan direction is effectively reducing threats to listed fish species, their habitats, and other SWRA resources. If not effective, adaptive management will adjust forest plan direction as necessary;

- Adaptive management provides the mechanism to modify management actions in response to monitoring and evaluation results, changes in laws or regulations, or new information. This includes the ability to make appropriate modifications to restoration direction, mitigation measures, budgets, and monitoring approaches;

- The monitoring program will be complementary with ongoing broad- and mid-scale monitoring programs, for example the Pacfish and Infish Interagency Implementation Team monitoring program. This will allow Forest monitoring to be included with basin-level assessments of recovery/restoration activities for listed fish species and their habitats. Monitoring will be conducted at multiple scales to ensure that management actions are consistent with the context of broad and local recovery and restoration goals and objectives;

- Effectiveness, implementation, and validation monitoring over the life of the plan will be key to determining if individually and collectively management actions have maintained or improved SWRA resources. Multiple sites, representing various ecological conditions, across the Forest will be used. A similar approach will also address changes in TEPC species distributions and abundance, and success of restoration and conservation measures in moving subwatersheds toward their desired conditions.

- Accountability and oversight provided by the monitoring plan will allow adjustments needed to ensure the appropriate rate in achieving restoration goals and objectives is being accomplished. This could include, but not be limited to, adjusting budget allocations, shifting restoration prioritizations, or changing management direction or level of activity for a given area.

Definitions Of ESA Effects Thresholds And Examples

The following are definitions of ESA effects or effects determinations, including thresholds and examples.

Adverse Effect - For Forest Plan revision, "adverse effect" is used in the context of the Endangered Species Act relative to effects on Threatened, Endangered, Proposed, and Candidate (TEPC) species. Definitions are from the *Final Endangered Species Consultation Handbook* (USDI FWS and US Dept of Commerce NMFS 1998). They include both "likely to adversely effect" and "not likely to adversely effect". Both of these definitions are needed to clearly understand the intent of the phrase "adverse effect" when applied to Forest-wide and management area direction involving TEPC species.

The following is a definition specific to anadromous salmonids developed by NMFS, the Forest Service, and the BLM during the Pacfish consultation and is given as example: "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, reduce reproductive success, delayed, or premature migration, or other adverse 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" (US Dept of Commerce NMFS 1995).

No Effect - This determination is appropriate only "…if the proposed action will literally have no effect whatsoever on the species and/or critical habitat, not a small effect or an effect that is unlikely to occur" (USDI FWS and US Dept of Commerce NMFS 1998). Furthermore, actions that result in a "beneficial effect" do not qualify as a "no effect" determination. If a "no effect" determination is derived, conference/consultation does not need to proceed, but it is recommended that these determinations be shared within the Level 1 consultation team. Documentation to substantiate this determination must be filed in the project record.

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. 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 judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur" (USDI FWS and US Dept of Commerce 1998). The term "negligible" has been used in many ESA consultations in the Snake River Basin. This term is considered synonymous with "insignificant" as described above. Consultation/conference is required for this effect determination, but can proceed as informal.

May Affect, Likely To Adversely Affect - The appropriate finding in a biological assessment (or conclusion during informal consultation) if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial (see definition of "not likely to adversely affect"). In the event the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action is "likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made. A "likely to adversely affect" determination requires the initiation of formal Section 7 consultation.

For the purposes of Section 7, any action that has more than a negligible potential to result in "take" (see definition below) is likely to adversely affect a proposed/listed species. It is not possible for NOAA Fisheries or USFWS to concur on a "not likely to adversely affect" determination if the proposed action will cause take of the listed species. 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 individuals; thus actions that have more than a negligible potential to cause take of individual eggs and/or fish are "likely to adversely affect."

Likely To Jeopardize The Continued Existence Of - The Code of Federal regulations define jeopardy as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR §402.02).

Take - To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct [ESA §3(19)]. Harm is further defined by USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by USFWS as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering (50 CFR § 17.3).

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