9.0 Environmental Setting

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Chapter Summary

- The BA should provide a brief description of general habitat and environmental conditions within the action area and summarize previous actions or developments and their relevance to the status of listed species in the action area.
- For terrestrial and marine species, environmental conditions within the action area that are pertinent to the species' habitat requirements should be described.
- The environmental baseline discussion should describe habitat elements, significant to the species being addressed, that will be affected by the proposed action or that would affect the use of the action area by listed species.
- The environmental baseline analysis of freshwater systems can be completed at multiple scales.
- If bull trout or bull trout critical habitat is addressed in a BA, the USFWS matrix of pathways and indicators should be used to document the pathways of effects and indicators of those effects to the species or habitat.
- Detailed environmental baseline discussions for each of the USFWS pathways and indicators addressed in the BA should be included in the BA appendices.
- Summary tables of freshwater baseline conditions should be included within the text of the BA.
- At a minimum, the BA should assess the USFWS pathways and indicators that could be affected by the proposed action and that could result in effects on bull trout or bull trout suitable and critical habitat.
- The NMFS matrix of pathways and indicators can be used as a diagnostic tool to analyze pathways of effects. However, NMFS no longer requires the matrix to be in all BAs.
- For projects with stormwater impacts that will potentially affect listed fish species under NMFS's jurisdiction, only the water quality indicators (temperature, sediment, and chemical contamination) should be included in the body of the BA. For those projects, a detailed description of the

indicators should be provided in the body of the BA. The status of the water quality indicators is used in the stormwater effects analysis (see CHAPTER 17 – STORMWATER IMPACT ASSESSMENT).

This chapter discusses the types of information to be included in a BA pertaining to existing environmental conditions within the action area. The discussion of baseline environmental conditions is usually divided into two sections: 1) terrestrial and marine species, and 2) freshwater aquatic species. Accordingly, this chapter is divided into two corresponding sections.

9.1 Terrestrial and Marine Species: Environmental Baseline Information

This section provides guidance for documenting environmental conditions within the action area that are relevant for terrestrial and marine species that may be present.

The project biologist should describe existing environmental conditions and habitat features (with a focus on suitable habitat and critical habitat) within the action area. Some project biologists first describe these conditions in general, and then provide more detail including findings from site visits. Other BA authors combine general and specific information regarding environmental conditions and species present.

One excellent resource for describing existing environmental conditions within watersheds is the Habitat Limiting Factors report series prepared by the Washington Conservation Commission. A summary report for all water resource inventory areas (WRIAs) with references to individual WRIAs is available at < https://rco.wa.gov/wp-content/uploads/2019/10/GSRO-LimitingFactorReport.pdf>.

The baseline discussion should summarize the actions that have (and continue to) occur in the action area and describe how these actions have influenced environmental conditions and the status of the species in the action area. The species' response to the resulting environmental conditions should also be included in the baseline discussion. The baseline discussion should focus on the trends or characteristics in the environment of the action area that are relevant to the listed species.

The environmental conditions that are pertinent to the terrestrial and marine species addressed in the BA should be described in detail, to provide reviewers with a clear sense of the features present and how they may be affected by the proposed action. Habitat characteristics that are suitable for various behavioral or life history requirements (e.g., foraging, nesting, denning, dispersal, and migration) should also be described in detail. These characteristics will vary depending upon the species addressed in the BA and their respective habitat requirements. In addition, the environmental baseline section also establishes the starting point for the effects analysis for critical habitat and should include a detailed description of the current functional

condition of the individual physical or biological features (if defined) within the action area. The discussion should describe baseline or existing habitat elements or functions that will be affected by the proposed project activities in detail.

The condition of the environmental baseline will influence the effects analysis in that the response of the species and critical habitat in the action area to the proposed action will depend, in part, on existing environmental conditions.

9.2 Freshwater Aquatic Species: Environmental Baseline Information

This brief section provides guidance for addressing and documenting aquatic environmental baseline conditions in relation to a project. In addition, general information and resources for this analysis and the NMFS and USFWS matrices and tables are provided.

Both NMFS and USFWS have developed documents to outline frameworks for providing consistent and logical lines of reasoning to aid in determining when, where, and why listed species suffer adverse effects. The documents provide diagnostic matrices, environmental baseline checklists, and dichotomous keys for making determinations of effect and documenting expected incidental *take*. The tables facilitate the documentation of the environmental baseline conditions and potential effects of the proposed action on relevant indicators for the aquatic environment. These documents originally were developed to provide the information needed to evaluate effects of proposed and ongoing land management actions of the U.S. Forest Service and U.S. Bureau of Land Management related to the persistence and potential recovery of proposed and listed salmonids. As a result, the matrices are not well adapted for characterizing conditions in urban areas or specific locations within a watershed. However, the matrices can aid project biologists in diagnosing pathways of effects and indicators of those effects.

For BAs that include effects to bull trout or bull trout critical habitat, the USFWS pathway and indicator matrix should be included in the body of the document, with a brief discussion of each indicator that could be potentially affected by project activities. The pathways and indicators that could be affected by a proposed action and that could result in effects on listed species and critical habitat should be assessed within the body of the BA. The checklist for documenting the environmental baseline and effects of the proposed action(s) on relevant indicators (see Table 9-7) should also be included in the body of the BA. Text to accompany the indicators that will not be affected by a proposed action can be placed in an appendix of the BA.

The NMFS matrix can be used as an aid for diagnosing pathways of effects and indicators of those effects. However it is no longer required that all the pathways and indicators in the matrix document be analyzed in a BA. Projects with stormwater impacts that will potentially affect listed fish species under NMFS jurisdiction will need to do a detailed description of the baseline water quality conditions (temperature, sediment, and chemical contamination) in the body of the BA. The checklist for documenting the environmental baseline of the water quality indicators

and effects of the proposed action(s) on those indicators (see Table 9-5) should also be included in the body of the BA. The water quality indicators are used to analyze potential stormwater impacts to listed fish species and their suitable or critical habitats (Refer to CHAPTER 17 – STORMWATER IMPACT ASSESSMENT for more information).

9.2.1 The Importance of Scale in Analysis of Environmental Baseline Conditions

In describing the environmental baseline conditions for projects potentially affecting aquatic species, a project biologist should think carefully about what scale is most appropriate for their analysis before assessing whether baseline indicators and pathways are properly functioning, at risk, or are not properly functioning at the action area scale, the project setting scale, and/or the watershed scale. NMFS has a preference for this information being evaluated at the watershed scale. However it can be useful to catalogue conditions and impacts at a smaller scale particularly if the area of aquatic impacts does not mirror the action area defined for the project.

The project biologist may begin by characterizing baseline conditions at a project footprint or zone of effect scale, an action area scale, and/or a watershed scale, and then subsequently analyzing the impacts of the project by juxtaposing the project impacts at different scales within the watershed. This form of analysis provides greater contextual information for determining the small- and large-scale impacts of a project.

Some BAs begin with a detailed project setting or a watershed description immediately followed by a discussion of environmental baseline conditions pertaining to the action area. This approach allows the author to present a scaled view of the environmental conditions in the watershed versus the action area. Another possible approach would be to provide a scaled discussion of the action area versus the location of proposed work or a smaller zone of effect within the larger action area. In some projects, an author may choose to provide general information at the environmental setting or watershed level and detailed environmental baseline information only at the smallest applicable scale.

For example, a project biologist may plan to discuss environmental baseline conditions and impacts on them at a large scale juxtaposed with a discussion of environmental baseline conditions at the action area scale, to include in the ENVIRONMENTAL BASELINE OF ACTION AREA section of the BA. Similarly, a project biologist may choose to evaluate environmental baseline conditions only at the action area scale juxtaposed with a description of conditions at the zone of effect scale.

For projects that may affect designated or proposed critical habitat, the environmental baseline section should include a detailed description of the current functional condition of the individual PBFs within the action area. The subsequent analysis of project effects will focus on impacts upon specific PBFs. The condition of the environmental baseline will influence the effects analysis in that the effects on the critical habitat in the action area to the proposed action will depend, in part, on existing environmental conditions.

9.3 Information and Resources

There are several sources of information pertaining to assessments of environmental baseline conditions:

- *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (NMFS 1996).
- *A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale* (USFWS 1998).
- Washington Conservation Commission 1999–2003 Limiting Factors Analysis reports for Washington State WRIAs. Reports can be searched for by WRIA online at https://rco.wa.gov/wp-content/uploads/2019/10/GSRO-LimitingFactorReport.pdf>.
- *A Catalog of Washington Streams and Salmon Utilization*, Volumes 1 (Puget Sound) and 2 (Coastal). Washington Department of Fisheries. November 1975. Available online:< WRIAs.pdf (streamnetlibrary.org)>
- Clean Water Act Section 303(d) lists provided by the Department of Ecology for threatened waters in the state of Washington. Available online: https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Assessment-of-state-waters-303d
- 2000 Salmonid Stock Inventory Available on line: <https://wdfw.wa.gov/sites/default/files/publications/00192/wdfw00192.pdf>.
- 2000 Washington State Salmon and Steelhead Stock Inventory (SASSI) – Coastal cutthroat trout appendix. Washington Department of Fish and Wildlife and Western Washington Treaty Tribes. Available online: <http://wdfw.wa.gov/publications/pub.php?id=00192>.
- 2004 Washington State Salmon and Steelhead Stock Inventory (SASSI) – Bull trout appendix. Washington Department of Fish and Wildlife and Western Washington Treaty Tribes. Available online: <https://wdfw.wa.gov/publications/00193>.
- Local municipality or county sensitive areas databases and reports, basin plans, watershed reports, and project BAs contain valuable site-specific information. Project biologists should contact the nearest county or municipality environmental or planning office to determine the availability of these resources.

9.4 NMFS and USFWS Matrices

The Services have developed matrices and tables to evaluate the effects of proposed and ongoing land management actions. The NMFS matrix is no longer included in BAs except to detail water quality conditions (temperature, sediment, and chemical contamination) for the stormwater analysis (see CHAPTER 17 – STORMWATER IMPACT ASSESSMENT for more information). If included, the NMFS matrix should be included as an appendix and discussed in the body of the BA.

The USFWS matrix should be used for assessing and documenting environmental baseline conditions in the action area of proposed projects with adverse effects to bull trout or bull trout critical habitat. These tools are provided in Tables 9-4 through 9-7.

Table 9-1. NMFS matrix of pathways and indicators.

Pathway	Indicators [a]	Properly Functioning	At Risk	Not Properly Functioning
Water Quality	Temperature	50–57ºF [b]	57-60º (spawning) 57-64º (migration &rearing) [c]	> 60º (spawning) > 64º (migration & rearing) [c]
	Sediment/turbidity	<12% fines (<0.85 mm) in gravel [d], turbidity low	12-17% (west-side) [d], 12-20% (east-side) [c], turbidity moderate	>17% (west-side) [d], >20% (east side) [c] fines at surface or depth in spawning habitat [c], turbidity high
	Chemical contamination and nutrients	Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no Clean Water Act 303(d) designated reaches	Moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one Clean Water Act 303(d) designated reach [f]	High levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one Clean Water Act 303(d) designated reach [f]
Habitat Access	Physical barriers	Any manmade barriers present in watershed allow upstream and downstream fish passage at all flows	Any manmade barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	Any manmade barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows
Habitat Elements	Substrate	Dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness <20% [d]	Gravel and cobble is subdominant, or if dominant, embeddedness 20-30% [d]	Bedrock, sand, silt or small gravel dominant, or if gravel and cobble dominant, embeddedness >30%[c]
	Large woody debris	Coast: >80 pieces/mile >24-inch diameter, >50 ft. length;[e] East side: >20 pieces/ mile >12-inch diameter, >35 ft. length;[c] and adequate sources of woody debris recruitment in riparian areas	Currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain that standard	Does not meet standards for properly functioning and lacks potential large woody debris recruitment
	Pool frequency channel width # pools/mile [g] 5 feet 184 10 inches 96 15 inches 70 20 inches 56 25 inches 47 75 inches 23 100 inches 18	Meets pool frequency standards (left) and large woody debris recruitment standards for properly functioning habitat (above)	Meets pool frequency standards but large woody debris recruitment inadequate to maintain pools over time	Does not meet pool frequency standards

Table 9-1 (continued). NMFS matrix of pathways and indicators.

Pathway	Indicators [a]	Properly Functioning	At Risk	Not Properly Functioning
Habitat Elements (continued)	Pool quality	Pools >1 meter deep (holding pools) with good cover and cool water [d], minor reduction of pool volume by fine sediment	Few deeper pools (>1 meter) present or inadequate cover/temperature [d], moderate reduction of pool volume by fine sediment	No deep pools (>1 meter) and inadequate cover/temperature [d], major reduction of pool volume by fine sediment
	Off-channel habitat	Backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.) [d]	Some backwaters and high energy side channels [d]	Few or no backwaters, no off-channel ponds [d]
	Refugia (important remnant habitat for sensitive aquatic species)	Habitat refugia exist and are adequately buffered (e.g., by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations [h]	Habitat refugia exist but are not adequately buffered (e.g., by intact riparian reserves); existing refugia are insufficient in size, number and connectivity to maintain viable populations or sub-populations [h]	Adequate habitat refugia do not exist [h]
Channel Condition & Dynamics:	Width/depth ratio	<10[c,e]	10–12 [n]	>12 [n]
	Stream bank condition	>90% stable; i.e., on average, less than 10% of banks are actively eroding [c]	80–90% stable	<80% stable
	Floodplain connectivity	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly
Flow/Hydrology:	Change in peak/base flows	Watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography	Some evidence of altered peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	Pronounced changes in peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography
	Increase in drainage network	Zero or minimum increases in drainage network density due to roads [i,j]	Moderate increases in drainage network density due to roads (e.g., 5%) [i,j]	Significant increases in drainage network density due to roads (e.g., 20-25%) [i,j]
Watershed Conditions:	Road density & location	<2 mi/mi² [l], no valley bottom roads	2–3 mi/mi², some valley bottom roads	>3 mi/mi², many valley bottom roads

Table 9-1 (continued). NMFS matrix of pathways and indicators.

Pathway	Indicators [a]	Properly Functioning	At Risk	Not Properly Functioning
Watershed Conditions (continued):	Disturbance history	<15% ECA (entire watershed) with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), 15% retention of LSOG in watershed [k]	<15% ECA (entire watershed) but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), 15% retention of LSOG in watershed [k]	>15% ECA (entire watershed) and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG retention
	Riparian reserves	The riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact),and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/ composition >50% [m]	Moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian reserve system, or incomplete protection of habitats and refugia for sensitive aquatic species (70-80% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better [m]	Riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitats and refugia for sensitive aquatic species (<70% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition <25% [m]

[a] The ranges of criteria presented here are not absolute; they may be adjusted for unique watersheds.

[b] Bjornn, T.C. and D.W. Reiser. 1991. Habitat Requirements of Salmonids in Streams. American Fisheries Society Special Publication 19:83-138. W.R. Meehan, ed.

[c] 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.

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

[e] 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.

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

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

[h] 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), pp. 449–456.

[i] Wemple, B.C. 1994. Hydrologic Integration of Forest Roads with Stream Networks in Two Basins, Western Cascades, Oregon. M.S. Thesis, Geosciences Department, Oregon State University.

[j] e.g., see Elk River Watershed Analysis Report, 1995. Siskiyou National Forest, Oregon.

[k] Northwest Forest Plan. 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management.

[l] USDA Forest Service. 1993. Determining the Risk of Cumulative Watershed Effects Resulting from Multiple Activities.

[m] Winward, A.H. 1989. Ecological Status of Vegetation as a base for Multiple Product Management. Abstracts 42nd annual meeting, Society for Range Management, Billings MT, Denver CO: Society For Range Management: p. 277.

[n] No reference available.

Table 9-2. NMFS checklist for documenting environmental baseline and effects of proposed action(s) on relevant indicators.

Pathways Indicators	Environmental Baseline			Effects of the Action(s)		
	Properly [a] Functioning	At Risk [a]	Not Properly [a] Functioning	Restore [b]	Maintain [c]	Degrade [d]
Water Quality						
Temperature						
Sediment						
Chem. contam./nutrients						
Habitat Access						
Physical barriers						
Habitat Elements						
Substrate						
Large woody debris						
Pool frequency						
Pool quality						
Off-channel habitat						
Refugia						
Channel Cond. & Dynamics						
Width/depth ratio						
Stream bank condition						
Floodplain connectivity						
Flow/Hydrology						
Peak/base flows						
Drainage network increase						
Watershed Conditions						
Road density & location						
Disturbance history						
Riparian reserves						

[a] These three categories of function (*properly functioning*, *at risk*, and *not properly functioning*) are defined for each indicator in the matrix of pathways and indicators (Table 9-4).

[b] For the purposes of this checklist, *restore* means to change the function of an *at risk* indicator to *properly functioning*, or to change the function of a *not properly functioning* indicator to *at risk* or *properly functioning* (i.e., it does not apply to *properly functioning* indicators).

[c] For the purposes of this checklist, *maintain* means that the function of an indicator does not change (i.e., it applies to all indicators regardless of functional level).

[d] For the purposes of this checklist, *degrade* means to change the function of an indicator for the worse (i.e., it applies to all indicators regardless of functional level). In some cases, a *not properly functioning* indicator may be further worsened, and this should be noted.

Table 9-3. USFWS matrix of diagnostics—pathways and indicators.

Diagnostic or Pathway	Indicators [a]	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Species				
Subpopulation characteristics within subpopulation watersheds	Subpopulation size	Mean total subpopulation size or local habitat capacity greater than several thousand individuals. All life stages evenly represented in subpopulation. [b]	Adults in subpopulation are less than 500 but >50. [b]	Adults in subpopulation are less than 50. [b]
	Growth and survival	Subpopulation has the resilience to recover from short-term disturbances (e.g., catastrophic events), or subpopulation declines within one to two generations (5 to 10 years). [b] Subpopulation is characterized as increasing or stable. At least 10+ years of data support this estimate. [c]	When disturbed, the subpopulation 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. [b] At least 10+ years of data support this characterization. [c] If less data is available and a trend cannot be confirmed, a subpopulation will be considered at risk until enough data is available to accurately determine its trend.	The subpopulation is characterized as in rapid decline or is maintaining at alarmingly low numbers. Under current management, the subpopulation condition will not improve within two generations (5 to 10 years). [b] This is supported by a minimum of 5+ years of data.
	Life history diversity and isolation	Migratory form is present, and subpopulation exists near other spawning and rearing groups. Migratory corridors and rearing habitat (lake or larger river) are in good to excellent condition for the species. Neighboring subpopulations are large, with high likelihood of producing surplus individuals or straying adults that mix with other subpopulation groups. [b]	The migratory form is present but the subpopulation is not close to other subpopulations or habitat disruption has produced a strong correlation among subpopulations that do exist in proximity to each other. [b]	The migratory form is absent and the subpopulation is isolated to the local stream or a small watershed not likely to support more than 2,000 fish. [b]
	Persistence and genetic integrity	Connectivity is high among multiple subpopulations (five or more) with at least several thousand fish each. Each relevant subpopulation has low risk of extinction. [b] Probability of hybridization or displacement by competitive species is low to nonexistent.	Connectivity among multiple subpopulations does occur, but habitats are more fragmented. Only one or two of the subpopulations represent most of the fish production. [b] The probability of hybridization or displacement by competitive species is imminent, although few documented cases have occurred.	Little or no connectivity remains for refounding subpopulations in low numbers, in decline, or nearing extinction. Only a single subpopulation or several local populations that are very small or that otherwise are at high risk remain. [b] Competitive species readily displace bull trout. The probability of hybridization is high and documented cases have occurred.

Table 9-3 (continued). USFWS matrix of diagnostics—pathways and indicators.

Diagnostic or Pathway	Indicators [a]	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Habitat				
Water quality	Temperature	7-day average maximum temperature in a reach during these life history stages: [b,d] Incubation 2 – 5ºC Rearing 4 – 12ºC Spawning 4 – 9ºC Also, temperatures do not exceed 15ºC in areas used by adults during migration (no thermal barriers).	7 day average maximum temperature in a reach during the following life history stages:[b, d] Incubation <2ºC or 6ºC Rearing <4ºC or 13 - 15ºC Spawning <4ºC or 10ºC Also, temperatures in areas used by adults during migration sometimes exceeds 15ºC.	7 day average maximum temperature in a reach during the following life history stages: [b, d] Incubation <1ºC or >6ºC Rearing >15ºC Spawning <4ºC or > 10ºC also temperatures in areas used by adults during migration regularly exceed 15ºC (thermal barriers present).
	Sediment (in areas of spawning & incubation; address rearing areas under *substrate embeddedness*)	Similar to Chinook salmon,[b] for example: <12% fines (<0.85 mm) in gravel,[e] ≤20% surface fines ≤6 mm. [f,g]	Similar to Chinook salmon: [b] e.g., 12-17% fines (<0.85mm) in gravel, [e] e.g., 12-20% surface fines. [h]	Similar to Chinook salmon [b]: e.g., >17% fines (<0.85mm) in gravel;[e] e.g., >20% fines at surface or depth in spawning habitat. [h]
	Chemical contamination & nutrients	Low levels of chemical contamination from agricultural, industrial, and other sources; no excess nutrients; no Clean Water Act 303(d) designated reaches. [i]	Moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one Clean Water Act 303(d) designated reach. [i]	High levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one Clean Water Act 303(d) designated reach. [i]
Habitat access	Physical barriers (address subsurface flows impeding fish passage under *flow/hydrology*)	Manmade barriers present in watershed allow upstream and downstream fish passage at all flows.	Manmade barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	Manmade barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows.
Habitat elements	Substrate embeddedness in rearing areas (address spawning & incubation areas under the indicator *sediment*)	Reach embeddedness <20%. [j,k]	Reach embeddedness 20-30%. [j,k]	Reach embeddedness >30%. [e,k]
	Large woody debris (LWD)	Current values being maintained at: On the coast, >80 pieces/mile (>24-inch diameter, >50 ft length), [j] On the east side, >20 pieces/mile (>12-inch diameter, >35 ft length). [l] Adequate woody debris sources available for long- and short-term recruitment.	Current levels are being maintained at minimum levels desired for "functioning appropriately", but potential sources for long term woody debris recruitment are lacking to maintain these minimum values.	Current levels are not at those desired values for "functioning appropriately", and potential sources of woody debris for short and/or long term recruitment are lacking.

Table 9-3 (continued). USFWS matrix of diagnostics—pathways and indicators.

Diagnostic or Pathway	Indicators [a]	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Habitat (continued)				
	Pool frequency & quality	Pool frequency in a reach closely approximates [f]: Wetted width (ft) — # pools/mile 0–5 — 39 5–10 — 60 10–15 — 48 15–20 — 39 20–30 — 23 30–35 — 18 35–40 — 10 40–65 — 9 65–100 — 4 (can use formula: pools/mi = 5,280/wetted channel width / #channel widths per pool); also, pools have good cover and cool water[e], and only minor reduction of pool volume by fine sediment	Pool frequency is similar to values in "functioning appropriately", but pools have inadequate cover/temperature[e], and/or there has been a moderate reduction of pool volume by fine sediment	Pool frequency is considerably lower than values desired for "functioning appropriately"; also cover/temperature is inadequate[e], and there has been a major reduction of pool volume by fine sediment
	Large pools (in rearing, adult holding, & overwintering reaches of >3 meters in wetted width at base flow)	Each reach has many large pools >1 meter deep. [e]	Reaches have few large pools (>1 meter) present[e]	Reaches have no deep pools (>1 meter)[e]
	Off-channel habitat (see reference 18 for identification of these characteristics)	Watershed has many ponds, oxbows, backwaters, and other off-channel areas with cover; and side-channels are low energy areas.[e]	Watershed has some ponds, oxbows, backwaters, and other off-channel areas with cover; but side-channels are generally high-energy areas[e]	Watershed has few or no ponds, oxbows, backwaters, or other off-channel areas[e]
	Refugia (see checklist footnotes for definition of this indicator)	Habitats capable of supporting strong and significant populations are protected and are well distributed and connected for all life stages and forms of the species.[m, n]	Habitats capable of supporting strong and significant populations are insufficient in size, number and connectivity to maintain all life stages and forms of the species[m, n]	Adequate habitat refugia do not exist[m]
Channel condition & dynamics	Average wetted width/ maximum depth ratio in scour pools in a reach	≤10[h, f]	11–20[f]	>20[f]
	Stream bank condition	>80% of any stream reach has ≥90% stability.[f]	50–80% of any stream reach has ≥90% stability[f]	<50% of any stream reach has ≥90% stability[f]

Table 9-3 (continued). USFWS matrix of diagnostics—pathways and indicators.

Diagnostic or Pathway	Indicators [a]	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Habitat (continued)				
Channel condition & dynamics (continued)	Floodplain connectivity	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession.	Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly
Flow/hydrology	Change in peak & base flows	Watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology, and geography.	Some evidence of altered peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	Pronounced changes in peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography
	Increase in drainage network	Zero or minimum increases in active channel length correlated with human caused disturbance.	Low to moderate increase in active channel length correlated with human caused disturbance	Greater than moderate increase in active channel length correlated with human caused disturbance
Watershed conditions	Road density and location	<1 mi/mi², [n] no valley bottom roads.	1–2.4 mi/mi², [n] some valley bottom roads	>2.4 mi/mi² [n]; many valley bottom roads
	Disturbance history	<15% ECA of entire watershed with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area there is an additional criterion of 15% LSOG in watersheds. [o]	<15% ECA of entire watershed but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area there is an additional criterion of 15% LSOG in watersheds. [o]	>15% ECA of entire watershed and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG
	Riparian conservation areas (RHCA – PACFISH and INFISH) (riparian reserves – Northwest Forest Plan)	The riparian conservation areas provide adequate shade, large woody debris recruitment, and habitat protection and connectivity in subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact), and adequately buffer impacts on rangelands: percent similarity of riparian vegetation to the potential natural community/ composition >50%.[p]	Moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian conservation areas, or incomplete protection of habitats and refugia for sensitive aquatic species (70–80% intact), and adequately buffer impacts on rangelands : percent similarity of riparian vegetation to the potential natural community/composition 25–50% or better. [p]	Riparian conservation areas are fragmented, poorly connected, or provides inadequate protection of habitats for sensitive aquatic species (<70% intact, refugia does not occur), and adequately buffer impacts on rangelands : percent similarity of riparian vegetation to the potential natural community/composition <25%[p]
	Disturbance regime	Environmental disturbance is short lived; predictable hydrograph, high quality habitat and watershed complexity providing refuge and rearing space for all life stages or multiple life-history forms. [b] Natural processes are stable.	Scour events, debris torrents, or catastrophic fire are localized events that occur in several minor parts of the watershed. Resiliency of habitat to recover from environmental 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. [b] Natural processes are unstable.

Table 9-3 (continued). USFWS matrix of diagnostics—pathways and indicators.

Diagnostic or Pathway	Indicators [a]	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Species and Habitat				
Integration of species and habitat conditions		High habitat quality and connectivity among subpopulations. Migratory form is present. Disturbance has not altered channel equilibrium. Fine sediments and other habitat characteristics influencing survival or growth are consistent with pristine habitat. Subpopulation has resilience to recover from short-term disturbance within one to two generations (5 to 10 years). Subpopulation fluctuating around an equilibrium or is growing. [b]	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. Connectivity among subpopulations occurs but habitats are more fragmented. [b]	Cumulative disruption of habitat has resulted in a clear declining trend in the subpopulation size. Under current management, habitat conditions will not improve within two generations (5 to 10 years). Little or no connectivity remains among subpopulations. The subpopulation survival and recruitment responds sharply to normal environmental events. [b]

[a] The values of criteria presented here are not absolute; they may be adjusted for local watersheds given supportive documentation.

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

[c] 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.

[d] Buchanan, D.V. and S.V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. In W.C. Mackay, M.K. Brewin, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings. P8.

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

[f] 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.

[g] 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.

[h] 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.

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

[j] 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.

[k] 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. U.S. Environmental Protection Agency report. Contract No. R008224-01-5.

[l] Interior Columbia Basin Ecosystem Management Project Draft Environmental Impact Statement and Appendices.

[m] 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.

[n] 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.

[o] ECA = equivalent clear-cut area. LSOG = late-stage old growth. NWFP = Northwest Forest Plan.
Northwest Forest Plan. 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management.

[p] Winward, A.H. 1989. Ecological Status of Vegetation as a Base for Multiple Product Management. Abstracts 42nd annual meeting, Society for Range Management, Billings MT, Denver CO: Society For Range Management: p. 277.

Table 9-4. USFWS checklist for documenting environmental baseline and effects of proposed action(s) on relevant indicators.

Diagnostics/ Pathways: Indicators	Population and Environmental Baseline (list values or criteria and supporting documentation)			Effects of the Action(s)			
	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk	Restore [a]	Maintain [b]	Degrade [c]	Compliance with ACS
Subpopulation Characteristics:							
Subpopulation size							
Growth & survival							
Life history diversity & isolation							
Persistence & genetic integrity							
Water Quality:							
Temperature							
Sediment							
Chemical contaminants & nutrients							
Habitat Access:							
Physical barriers							
Habitat Elements:							
Substrate embeddedness							
Large woody debris							
Pool frequency & quality							
Large pools							
Off-channel habitat							
Refugia [d]							
Channel Conditions & Dynamics:							
Wetted width/max depth ratio							
Stream bank condition							
Floodplain connectivity							
Flow/Hydrology:							
Change in peak & base flows							
Drainage network increase							
Watershed Conditions:							
Road density & location							
Disturbance history							
Riparian conservation areas							
Disturbance regime							
Integration of Species & Habitat Conditions							

[a] For the purposes of this checklist, *restore* means to change the function of a *functioning at risk* indicator to *functioning appropriately*, or to change the function of a *functioning at unacceptable risk* indicator to *functioning at risk* or *functioning appropriately* (i.e., it does not apply to *functioning appropriately* indicators). Restoration from a worse condition to a better condition does not negate the need to consult or confer if *take* will occur.

[b] For the purposes of this checklist, *maintain* means that the function of an indicator does not change (i.e., it applies to all indicators regardless of functional level).

[c] For the purposes of this checklist, *degrade* means to change the function of an indicator for the worse (i.e., it applies to all indicators regardless of functional level). In some cases, a *functioning at unacceptable risk* indicator may be further worsened, and this should be noted.

[d] Refugia = watersheds or large areas with minimal human disturbance having relatively high quality water and fish habitat, or having the potential of providing high quality water and fish habitat with the implementation of restoration efforts. These high quality water and fish habitats are well distributed and connected within the watershed or large area to provide for both biodiversity and stable populations.

(Adapted from discussions in *Stronghold Watersheds and Unroaded Areas* in 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).