Version: 19 May 2002

# Appendix D

# Indicator Matrix for ESA-Listed Fish Species Terms

C

# TABLE D-1: INDICATOR MATRIX FOR ESA-LISTED FISH SPECIES[1]

| INDICATORS | PROPERLY FUNCTIONING | AT RISK | NOT PROPERLY FUNCTIONING |
|---|---|---|---|
| **Water Quality** | | | |
| Temperature[2] | *Bull trout:*<br>Incubation: 36-41°F<br>Rearing: 39-54°F<br>Spawning: 39-48°F<br>Migration: Less than 59°F<br>No thermal barriers<br>*Salmon species:*<br>50-57°F | *Bull trout:*<br>Incubation: 42-43°F<br>Rearing: 55-59°F<br>Spawning: 49-50°F<br>Migration: Occasionally greater than 59°F<br>*Salmon species:*<br>Spawning: 57-60°F<br>Migration and rearing: 57-64°F | *Bull trout:*<br>Incubation: Greater than 43°F<br>Rearing: Greater than 59°F<br>Spawning: Greater than 50°F<br>Migration: Greater than 59°F<br>*Salmon species:*<br>Spawning: Greater than 60°F<br>Migration and rearing: Greater than 64°F |
| Sediment & Turbidity | Less than 12% fines (less than 0.85 mm); low turbidity | 12-17% west side, 12-20% east side; moderate turbidity | Greater than 17% west side, greater than 20% east side; fines at surface or depth in spawning habitat; turbidity high |
| Chemical Contamination & Nutrients | Low levels of chemical contamination (from agricultural, stormwater runoff, industrial sources, etc.); no excess nutrients; no CWA 303d designated reaches | Moderate levels of chemical contamination (from agricultural, stormwater runoff, industrial sources, etc.); moderate excess nutrients; one CWA 303d designated reach | High levels of chemical contamination (from agricultural, stormwater runoff, industrial sources, etc.); high excess nutrients; more than one CWA 303d designated reach |
| **Habitat Access** | | | |
| Physical Barriers | Human-made barriers allow upstream and downstream fish passage for all flows | Human-made barriers restrict upstream and/or downstream fish passage at base or low flows | Human-made barriers restrict upstream and/or downstream fish passage at several flows |
| **Habitat Elements** | | | |
| Substrate | Dominant substrate is gravel or cobble (interstitial spaces clear) or embeddedness is less than 20% | Gravel or cobble is subdominant, or if dominant, embeddedness is 20-30% | Gravel or cobble is subdominant, or if dominant, embeddedness is greater than 30% |

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|---|---|---|---|
| **Habitat Elements** | | | |
| Large Woody Debris (LWD) | Coast: Greater than 80 pieces/mile (greater than 24" diameter, greater than 50' length)<br>East side: Greater than 20 pieces/mile (greater than 12" diameter, greater than 35' length)<br>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[2] | *Bull trout:*<br>Pool frequency in a reach approximates:<br>wetted width / #pools/mile<br>0-5' 39<br>5-10' 60<br>10-15' 48<br>15-20' 39<br>20-30' 23<br>30-35' 18<br>35-40' 10<br>40-65' 9<br>65-100' 4<br>Meets LWD recruitment standards for properly functioning habitat<br>*Salmon species:*<br>Pool frequency approximates:<br>channel width / #pools/mile<br>5' 184<br>10' 96<br>15' 70<br>20' 56<br>25' 47<br>50' 26<br>75' 23<br>100' 18<br>Meets LWD recruitment standards for properly functioning habitat | *Both bull trout and salmon species:*<br>Meets pool frequency standards but LWD recruitment inadequate to maintain pools overtime | *Both bull trout and salmon species:*<br>Does not meet pool frequency standards |

| INDICATORS | PROPERLY FUNCTIONING | AT RISK | NOT PROPERLY FUNCTIONING |
|---|---|---|---|
| Habitat Elements | | | |
| Pool Quality | Pools greater than 1 meter deep with good cover and cool water, minor reduction of pool volume by fine sediment | Few pools greater than 1 meter deep or inadequate cover/temperature, moderate reduction of pool volume by fine sediment | No pools greater than 1 meter deep and inadequate cover/temperature, major reduction of pool volume by fine sediment. |
| Large Pools[3] | Each reach has many large pools (greater than 1 meter deep in streams greater than 3 meters wide, used for adult holding, juvenile rearing, and overwintering) | Most reaches have a few large pools | Reaches have no deep pools |
| Off-channel Habitat | Backwaters with cover and low energy off-channel areas (ponds, oxbows, etc.) | Some backwaters and high energy side channels | Few or no backwaters, no off-channel ponds |
| Refugia | Habitat refugia exist and are adequately buffered by intact riparian reserves; refugia are sufficient in size, number, and connectivity to maintain viable populations or subpopulations | Habitat refugia exist but are not adequately buffered by intact riparian reserves; refugia are insufficient in size, number and connectivity to maintain viable populations or subpopulations | |
| **Channel Conditions and Dynamics** | | | |
| Width/Depth Ratio[2] | *Bull trout:*<br>Less than or equal to 10<br>*Salmon species:*<br>Less than 10 | *Bull trout:*<br>11-20<br>*Salmon species:*<br>10-12 | *Bull trout:*<br>Greater than 20<br>*Salmon species:*<br>Greater than 12 |
| Stream Bank Condition | Greater than 90% stable | 80-90% stable | Less than 80% stable |
| Floodplain Connectivity | Off-channel areas are frequently hydrologically connected to the 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, and succession | Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly |
| Channel Confinement | The reach is not channelized, directed or artificially bounded; meandering is not inhibited | The reach is artificially constrained or bounded at one point (i.e., a bridge or culvert is in place); some meandering is possible above and below the structure | The reach is extensively artificially channelized, directed, or bounded; meandering is not possible |

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|---|---|---|---|
| **Flow/Hydrology** | | | |
| Peak/Base Flow Changes | Watershed hydrograph indicated 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, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology, and geography | Pronounced changes in peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology, and geography |
| Drainage Network Increase | Zero or minimum increases in drainage network density due to road | Moderate increases in drainage network density due to roads (approximately 5-15%) | Significant increases in drainage network density due to roads (approximately 20-25%) |
| **Watershed Conditions** | | | |
| Road Density and Location | Less than 2 mile/mile, no valley bottom roads | 2-3 mile/mile, some valley bottom roads | Greater than 3 mile/mile, many valley bottom roads |
| Disturbance History | Less than 15% ECA (entire watershed) with no concentration of disturbance in unstable or potentially unstable areas and/or refugia, and/or riparian areas; and for NWFP areas (except AMAs), 15% retention of LSOG in watershed | Less than 15% ECA (entire watershed) but disturbance concentrated in unstable or potentially unstable areas and/or refugia, and/or riparian areas; and for NWFP areas (except AMAs), 15% retention of LSOG in watershed | Greater than 15% ECA (entire watershed) and disturbance concentrated in unstable or potentially unstable areas and/or refugia, and/or riparian areas; 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 (greater than 80% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition greater than 50% | Moderate loss of connectivity or function (shade, large woody debris 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. | Riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitats and refugia for sensitive species (less than 70% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition. |

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|---|---|---|---|
| **Genetic Diversity** | | | |
| Recruitment and Population Heterogeneity[3] | If bull trout habitat exists in the project area vicinity, the project action area contains several thousand individuals or is linked to such an area; no migration barriers exist between individual stocks; interactions with outside populations are possible; all life history types (i.e., anadromous, fluvial, adfluvial, or resident) are possible | If bull trout habitat exists or historically existed in the project area vicinity, the project action area has a bull trout population of 500-50 adults; there are no migration barriers; interactions with outside populations are possible; all life histories are possible | If bull trout habitat exists or historically existed in the project area vicinity, the project action area contains less than 50 individuals; recruitment, recolonization, and straying are not possible because of migration barriers; there is no potential for genetic introversion from outside stocks and no possibility of migration life history types |

Notes:
[1] Adapted from NMFS 1996 and WSDOT 1999
[2] Indicator has different criteria for bull trout and salmon species
[3] Indicator applies to bull trout only