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Watersheds at Risk:
Roads Threaten Bull Trout on the Bitterroot, Flathead and Lolo National Forests

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Executive Summary

The Bitterroot, Flathead and Lolo National Forests have conducted baseline bull trout risk assessments finding the majority of the sub-watersheds assessed are at risk from the effects of existing roads.

The Bitterroot found that, due to existing road densities and road locations, only 36% of the sub-watersheds assessed continue to Function Appropriately, while 64% are found to be either Functioning at Risk or Functioning at Unacceptable Risk.

The Flathead found that, due to existing road densities and road locations, only 30% of the sub-watersheds assessed continue to Function Appropriately, while 70% are found to be either Functioning at Risk or Functioning at Unacceptable Risk.

The Lolo found that, due to existing road densities and road locations, only 12% of the sub-watersheds assessed continue to Function Appropriately, while 88% are found to be either Functioning at Risk or Functioning at Unacceptable Risk.

Road reclamation is found necessary to restore appropriate function to watersheds damaged by roads.

Introduction, Methods, and Findings

This report summarizes baseline bull trout risk assessments conducted by and on the Bitterroot, Flathead and Lolo National Forests, particularly in terms of the effects of roads. The risk assessments assign a risk rating to each of 23 natural and human caused factors/indicators, then assign an overall rating integrating the 23 indicators of species and habitat conditions (USFWS 1998a, USFWS 1998b, Riggers et al 1998). Appendix A to this report lists the 23 indicators used in the risk assessments.

In order to focus on the most direct effects of roads, this report summarizes the baseline bull trout risk ratings assigned to just one of the 23 indicators, "Road Density and Location." Three risk ratings were used: Functioning Appropriately (FA), Functioning at Risk (FAR), and Functioning at Unacceptable Risk (FUR). The criteria used by the Bitterroot and Flathead in assigning the three risk assessment ratings for the "Road Density and Location" indicator (USFWS 1998a, USFWS 1998b) are as follows:

FA: Road densities in the watershed are <1 mi/mi^2.
There are no valley bottom roads.

FAR: Road densities in the watershed are 1.0 - 2.4 mi/mi^2.
There are some valley bottom roads.

FUR: Road densities in the watershed are >2.4 mi/mi^2.
There are many valley bottom roads.

The criteria used by the Lolo in assigning the three risk assessment ratings for the "Road Density and Location" indicator (USFS 1998b) are as follows:

FA: Road densities in the watershed are < 0.7 mi/mi^2, AND;
< 15% of the stream length in the watershed contains roads within 300 feet of the stream.

FAR: Road densities in the watershed are 0.7 mi/mi^2 - 1.7 mi/mi^2, AND;
15% - 30% of the stream length in the watershed contains roads within 300 feet of the stream.

FUR: Road densities in the watershed are > 1.7 miles/mile^2, AND;
> 30% of the stream length in the watershed contains roads within 300 feet of the stream.

This risk rating process is repeated for each of the 6th-Code Hydrologic Unit Code sub-watersheds assessed. These are often referred to as 6th-Code HUCs. In this report, they are simply referred to as sub-watersheds.

Bitterroot National Forest:

The Bitterroot National Forest provided baseline bull trout risk assessments (USFS 2004) for the 69 sub-watersheds comprising the Montana/Bitterroot River portion of the Forest. The Bitterroot's assessments find that, due to existing road densities and road locations, only 36% of the assessed sub-watersheds continue to Function Appropriately, while 32% are found to be Functioning at Risk and 32% are found to be Functioning at Unacceptable Risk. These figures are also shown in Table 1.

Table 1: Effects of Road Density and Location on the Function of 69 Sub-Watersheds Assessed by and on the Bitterroot National Forest

Diagnosis	Number of Sub-Watersheds	% of Total
Functioning Appropriately	25	36%
Functioning at Risk	22	32%
Functioning at Unacceptable Risk	22	32%

Flathead National Forest:

The Flathead National Forest provided baseline bull trout risk assessments (Gardner 2000a, 2000b and VanEimeren 2000a, 2000b) for 79 of the 169 sub-watersheds within the Flathead National Forest boundary. The remaining sub-watersheds were not assessed by the Flathead because they are either in Congressionally designated wilderness areas, are not known to be used by bull trout, or are located essentially on lands not administered by the US Forest Service.

The Flathead's assessments find that, due to existing road densities and road locations, only 30% of the assessed sub-watersheds continue to Function Appropriately, while 32% are found to be Functioning at Risk and 38% are found to be Functioning at Unacceptable Risk. These figures are also shown in Table 2.

Table 2: Effects of Road Density and Location on the Function of 79 Sub-Watersheds Assessed by and on the Flathead National Forest

Diagnosis	Number of Sub-Watersheds	% of Total
Functioning Appropriately	24	30%
Functioning at Risk	25	32%
Functioning at Unacceptable Risk	30	38%

Lolo National Forest:

The Lolo National Forest provided baseline bull trout risk assessments (Hendrickson 2000) for 170 sub-watersheds. The Lolo's assessments find that, due to existing road densities and road locations, only 12% of the assessed sub-watersheds continue to Function Appropriately, while 20% are found to be Functioning at Risk and 68% are found to be Functioning at Unacceptable Risk. These figures are also shown in Table 3.

Table 3: Effects of Road Density and Location on the Function of 170 Sub-Watersheds Assessed by and on the Lolo National Forest

Diagnosis	Number of Sub-Watersheds	% of Total
Functioning Appropriately	20	12%
Functioning at Risk	34	20%
Functioning at Unacceptable Risk	116	68%

A 1998 draft summary of the Lolo's earlier baseline bull trout risk assessments found that 59% of the sub-watersheds have "high" road density, 11% have "excessive" road density, 58% have more than 40 stream crossings, and 50% have a road within 300 feet of the stream for more than 30% of its length (USFS 1998). The Lolo's "Modified Bull Trout Matrix" (Riggers et al 1998) also displays how roads and their locations affect other aspects of watershed function, such as increases in the drainage network and changes in peak and base flows.

These types of findings illustrate the specificity and wealth of information the Forest Service has at its disposal as it considers the impacts of its roads and other management activities on the aquatic resources of the Bitterroot, Flathead and Lolo National Forests. This same wealth of information (e.g. USFS 2000) can and should be brought to bear on the pending revision of these Forest Plans and in the Forest-wide Roads Analysis Process required of each Forest (USFS 1999).

Scientific Basis for Road Reclamation to Benefit Bull Trout

The scientific literature contains a wealth of information concerning the many ways in which roads damage terrestrial and aquatic ecosystems. Indeed, over the past decade both scientists and land managers have come to view roads as "the major impact" leaving "the most lasting imprint on the landscape." (Johnson 1995 and Dombeck 1998, respectively, emphasis in original). Basin-wide studies have found "60 percent of the healthiest aquatic habitats occur in roadless or very low road density areas on federal land in the Columbia River Basin." (Dombeck 1998). Indeed Interior Columbia River Basin Ecosystem Management Project (ICBEMP) documents summarize the damaging effects of roads as follows:

> "High road densities and their locations within watersheds are typically correlated with areas of higher watershed sensitivity to erosion and sediment transport to streams. Road density also is correlated with the distribution and spread of exotic annual grasses, noxious weeds, and other exotic plants. Furthermore, high road densities are correlated with areas that have few large snags and few large trees that are resistant to both fire and infestation of insects and disease. Lastly, high road densities are correlated with areas that have relatively high risk of fire occurrence (from human caused fires), high hazard ground fuels, and high tree mortality." (USFS 1996, parenthesis in original).

In layperson terms, this means not only do the roads themselves impact watersheds and streams, but the logging they provide access for has removed the largest trees and left the more flammable logging slash and smaller trees behind for ignition by humans using those roads. In other words, roads and the management they provide access for, particularly logging, are the primary root of the "forest health crisis," not the suppression of wildfire.

Indeed, studies conducted on landscapes where recent large fires have burned conclude these ecosystems and their fish are well adapted to fire but not to roads.

> Fire and the associated hydrologic effects can be characterized as pulsed disturbances as opposed to the more chronic "press" effects linked to permanent roads or extended timber harvest activities. . . Arguably the recent fires might be viewed as a badly needed "house cleaning" for overstocked forests as well as an infusion of materials critical for the maintenance of productive [fish] habitats. . . It also is not clear that attempts to manipulate the structure and processes of whole ecosystems (i.e. beneficially manipulate the fire regime) can ever be successful. . . The perpetuation or expansion of existing road networks, and other activities might well erode the ability of [fish] populations to respond to the effects of large scale storms and other disturbances that we clearly cannot change. (Rieman et al, 1995, parenthesis in original).

In other words, fish evolved with large scale disturbances such as wildfire but did not evolve with roads. Retaining or building roads in a likely futile attempt to counter wildfire or restore fire regimes through logging will instead make watersheds less resilient and self-healing following inevitable natural disturbances.

In a nutshell, roads compromise watershed integrity and resiliency by altering how water flows. As subsurface water flows downhill in a watershed, it encounters roads cut horizontally into the hillside. Here it bleeds to the surface, meets with exposed soil, picks up sediment, and warms as it follows roads, ditches and culverts before finally reaching a stream. Subsurface water that once may have welled up cold and clean from beneath bull trout spawning gravels instead reaches the stream as warmer and muddier surface water, smothering eggs and fry with sediment and warming the stream to temperatures less productive for spawning. (Johnson 1995 and Brinckman 1996).

In even simpler terms for example, the Bitterroot National Forest determined its few surviving bull trout populations are located in watersheds with the least roads, stream crossings by roads, and timber harvest. Conversely, the Bitterroot found bull trout are absent in watersheds with the most roads, stream crossings by roads, and timber harvest. (Decker 1992).

ICBEMP and other studies indicate these negative effects cannot be eliminated simply by building better roads.

> Increasing road density is correlated with declining aquatic habitat conditions and aquatic integrity . . . An intensive review of the literature concludes that increases in sedimentation [of streams] are unavoidable even using the most cautious roading methods. (USFS 1996).
>
> Roads, through their interception and re-direction of sub-surface runoff, have had a major contributing emphasis. Restoration of the normal drainage phenomenon can be achieved through the use of road removal and obliteration. (Johnson 1995).

Indeed, road obliteration/decommissioning/reclamation is required for the conservation and recovery of threatened bull trout.

> Bull trout are less likely to use streams in highly roaded areas for spawning and rearing, and where found in highly roaded areas are less likely to be at strong population levels. . . The average road density in bull trout strongholds was 0.45 mi/mi^2, which is considerably less than the standard of 2-3 mi/mi^2 reported as adequate for populations of anadromous salmonids. Bull trout populations classified as "depressed" had an average watershed road density of 1.4 mi/mi^2 and bull trout typically were absent at an average road density of 1.7 mi/mi^2. . . Reduction of total miles of forest roads is an important component of watershed restoration. . . Many miles of roads must be "put to bed" by pulling culverts, resloping road beds, pulling fill and replanting. (USFWS 1998c).

The removal of culverts during road reclamation is indeed of primary concern to protect aquatic resources. As noted by Johnson (1995) the Flathead National Forest investigated why it was having culverts "consistently over-topped and blowing out," finding that subsurface water flow intercepted by roads and channeled to streams was contributing to the problem. Hammer (2000) documents a number of culverts that have blown out on the Flathead and cites a single Montana Department of Fish, Wildlife and Parks survey finding 52 partially plugged culverts and 13 culverts blown out in bull trout rearing and spawning streams in the Flathead's South Fork alone.

Fish and Wildlife Service (2002) has found "[w]hatever the design life, any crossing structure would have a 100% chance of failure over its installation life if it is not removed after the road is abandoned." A study conducted on the Lolo National Forest (Casselli et al 2000) found that the preemptive removal of a culvert can reduce the amount of dirt that enters the stream by 99.5% compared to leaving the culvert to inevitably fail. It is for this reason, for example, that Flathead Forest Plan Amendment 19's road reclamation program wisely requires that all stream-bearing culverts and bridges be removed from reclaimed roads to protect aquatic resources while securing grizzly bear and other wildlife habitat. (USFS 1995).

The scientific literature points clearly to the need for substantial road reclamation in order to restore bull trout habitat and recover threatened bull trout populations. The pending revision of the Bitterroot, Flathead and Lolo National Forest Plans offers an excellent opportunity for the Forest Service to develop watershed restoration programs that utilize road reclamation as the primary means to improve water quality, recover bull trout and other fish populations, and provide adequate wildlife security.

Conclusions

Baseline bull trout risk assessment summaries for the Bitterroot, Flathead and Lolo National Forests clearly indicate roads are a major factor in causing the majority of sub-watersheds to no longer function appropriately for bull trout. Moreover, a comparison of the risk assessment criteria with the scientific literature indicates these risk ratings may themselves be conservative.

As indicated earlier in this report, Fish and Wildlife Service (1998c) has found that:

> "[A]verage road density in bull trout strongholds was 0.45 mi/mi^2 . . . Bull trout populations classified as "depressed" had an average watershed road density of 1.4 mi/mi^2 and bull trout typically were absent at an average road density of 1.7 mi/mi^2.

Compare this to the road density criteria used by the Bitterroot and Flathead for assessing risk to bull trout. Sub-watersheds with road density <1 mi/mi^2 are considered to be Functioning Appropriately, sub-watersheds with road density 1 - 2.4 mi/mi^2 are considered to be Functioning at Risk, and sub-watersheds with road density >2.4 mi/mi^2 are considered to be Functioning at Unacceptable Risk (FWS 1998b).

This comparison suggests that sub-watersheds found to be Functioning Appropriately may no longer function as bull trout strongholds due to road density levels. Similarly, those found to be Functioning at Risk may have road densities at levels where bull trout are typically absent, rendering the Functioning at Unacceptable Risk rating somewhat redundant.

A similar comparison can be made to the Lolo criteria. Sub-watersheds with road density <0.7 mi/mi^2 are considered to be Functioning Appropriately, sub-watersheds with road density 0.7 - 1.7 mi/mi^2 are considered to be Functioning at Risk, and sub-watersheds with road density >1.7 mi/mi^2 are considered to be Functioning at Unacceptable Risk (Riggers et al 1998). While the Lolo's criteria square better with the scientific literature than those used by the Bitterroot and Flathead, the results may still be conservative.

In conclusion, while baseline bull trout risk assessment summaries for the Bitterroot, Flathead and Lolo National Forests clearly indicate roads are a major factor in causing the majority of sub-watersheds to no longer function appropriately for bull trout, these risk assessments should nonetheless be viewed as perhaps conservative.

Sources

Brinckman, Jonathan. 1996. Recovery means ripping up roads. Idaho Statesman news article. March 31, 1996.

Casselli, John; B. Riggers and A. Rosquist. 2000. Seigel Creek culvert removal water monitoring report. Lolo National Forest. February 14, 2000.

Decker, G.. 1992. Bull trout, brook trout and watershed health. Dry Times; Summer 1992. Darby, MT.

Dombeck, Mike. 1998. Forest Service protects roadless areas and announces development of new transportation policies. Press release from the U. S. Forest Service Chief. January 22, 1998.

Gardner, Beth. 2000a. Baseline condition for bull trout: Stillwater River Drainage, including disjunct populations of Tally Lake, Upper Stillwater Lake, Whitefish Lake, and Upper Whitefish Lake. Flathead National Forest, Tally Lake Ranger District. April 2000.

Gardner, Beth. 2000b. Baseline condition for bull trout: Swan River Drainage, including disjunct populations of Holland Lake and Lindbergh Lake. Flathead National Forest, Swan Lake Ranger District. May 2000.

Hammer, Keith. 2000. Counting culverts: An assessment of integrated road and culvert management on the Flathead National Forest. December 2002. Available at www.swanview.org.

Hendrickson, S. 2000. Middle Clark Fork River Section 7 Consultation Watershed Baseline Analysis, Lolo National Forest.

Johnson, Steven R.. 1995. Factors supporting road removal and/or obliteration. Memorandum from the Kootenai National Forest hydrologist to fire recovery hydrologists. February 6, 1995.

Reiman, Bruce, Danny Lee, Gwynne Chandler and Deborah Meyers. 1997. Does wildfire threaten extinction for salmonids? Responses of redband trout and bull trout following recent large fires on the Boise National Forest. USDA Forest Service, Intermountain Research Station; Boise, Idaho. 1997.

Riggers, B., D. Kramer, S. Henderickson, A. Rosquist, T. Stylte, and K. Cikanek. 1998. Lolo National Forest modified bull trout matrix: rationale used in evaluating baseline conditions. 1998.

Rosquist, Arne. 2004. Email message to Keith Hammer. May 11, 2004.

U. S. Fish and Wildlife Service. 1995. Biological opinion on Flathead Forest Plan Amendment 19. February 17, 1995 amending an earlier opinion of January 6, 1995.

U. S. Fish and Wildlife Service. 1998a. Biological opinion for the effects to bull trout from continuedimplementation of Land and Resource Management Plans and Resource Management Plans as amended by the Interim Strategy for Managing Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana, and Portions of Nevada (INFISH), and the Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho and Portions of California (PACFISH). Fish and Wildlife Service Regions 1 and 6. Appendix 2.

U. S. Fish and Wildlife Service. 1998b. A framework to assist in making Endangered Species Act determinations of effect for individual or grouped actions at the bull trout subpopulation watershed scale. 1998.

U. S. Fish and Wildlife Service. 1998c. Bull trout interim conservation guidance. December 9, 1998.

U. S. Fish and Wildlife Service. 2002. Biological opinion on the effects of the Moose Post-Fire Project on bull trout. November 14, 2002.

U. S. Forest Service. 1995. Amendment environmental assessment for Flathead Forest Plan Amendment 19. February 1995.

U. S. Forest Service. 1996. Status of the interior Columbia Basin: Summary of scientific findings. General technical report PNW-GTR-385. November 1996.

U. S. Forest Service. 1998. Overview of road decommissioning on the Lolo National Forest. Draft circa 1998.

U. S. Forest Service. 1999. Roads Analysis: Informing decisions about managing the National Forest transportation system. Washington Office Report FS-643. August 1999.

U. S. Forest Service. 2000. Lotus database files concerning road and stream data on the Flathead, Lolo and Bitterroot National Forests. Rob McCloud, Lolo National Forest and Pat VanEimeren, Flathead National Forest. March 2000.

U. S. Forest Service. 2004. Environmental Baseline for Hydrologic Units in the Bitterroot River for Bull Trout (Section 7 of the Endanger Species Act). Summer 2004 Update. Bitterroot National Forest. May 2004 Draft.

VanEimeren, Pat. 2000a. Baseline bull trout biological assessment for the North Fork and Middle Fork Flathead River Drainages. Flathead National Forest. May 2000.

VanEimeren, Pat. 2000b. Baseline bull trout biological assessment for the South Fork Flathead River Drainage. Flathead National Forest. May 2000.

VanEimeren, Pat. 2003. Email memorandum to Rob Carlin-FOIA Coordinator; and personal communication. April 15, 2003.

Appendix A

The 23 Indicators Used in Baseline Bull Trout Risk Assessments

From "Matrix of Diagnostics/Pathways and Indicators"
(USFWS 1998a)

1.	Subpopulation Size
2.	Growth and Survival
3.	Life History Diversity and Isolation
4.	Persistence and Genetic Integrity
5.	Temperature
6.	Sediment
7.	Chemical Contamination/Nutrients
8.	Physical Barriers
9.	Substrate Embeddedness
10.	Large Woody Debris
11.	Pool Frequency and Quality
12.	Large Pools
13.	Off-Channel Habitat
14.	Refugia
15.	Average Wetted Width/Maximum Depth Ratio
16.	Streambank Condition
17.	Floodplain Connectivity
18.	Change in Peak/Base Flows
19.	Increase in Drainage Network
20.	Road Density and Location
21.	Disturbance History
22.	Riparian Conservation Areas
23.	Disturbance Regime
Overall	Integration of Species and Habitat Conditions