Consideration of BASI submitted by commenters on the Flathead forest plan revision

Reed Kuennen, planning team wildlife biologist

2014

The references sections of the plan set of documents includes information considered to be best available scientific information as well as opposing scientific information discuss in NEPA documents. We may have used all or portions of the scientific information presented in the documents listed in the references section. If we received public comments submitting information as best available scientific information, the following document has comment boxes that respond to the information submitted by the public. Codes in the comment boxes are as follows:

If I used the reference I list as **AP**, **PC**, or **ME**.

AP Used during **assessment phase** to identify and evaluate conditions and trend of the 15 assessment topics identified in 36 CFR 219.6(b)

PC Used to inform **development of plan components** and evaluate environmental effects in (NEPA) documentation.

If I did not use the reference and do not consider it to be BASI, I put one of these codes in as a comment as to the accuracy, reliability, and relevance to the planning issues as described in 42.13:

NOT ACC **Not accurate** - Accuracy estimates, identifies, or describes the true condition of its subject matter using scientific methods; quantitatively; unbiased

NOT RLB **Not reliable** - Reliability indications peer reviewed or published; repeatable; logical conclusions

IRR **Irrelevant –** Relevance pertains to the issues under consideration at spatial and temporal scales appropriate to the plan area and to a land management plan

DATED There is a more up-to-date publication available on the same topic and/or publication was a preliminary report.

INC Study results are **inconclusive**

If the reference was something I wanted to explore further and may use, then I inserted

ACK **ACKNOWLEDGE** that this reference may be relevant and it may be used in the next planning stages.

CON **CONSIDERED** but addressed by other literature that is equally or more protective or encompassing.

November 18, 2013

Joe Krueger
Forest Plan Revision Acting Team Leader
Flathead National Forest
650 Wolfpack Way
Kalispell, MT 59901

Re: Land Management Plan Assessment Pursuant to 36 CFR 219.6

Dear Joe,

Please accept this input on behalf of The Wilderness Society in response to the Forest Service's request for data, scientific publications, expert opinions, or other relevant information for the Assessment Phase of the revision of the Flathead National Forest's Land Resources Management Plan ("Plan").

The Wilderness Society ("TWS") is a national non-profit organization established in 1935 to "protect wilderness and inspire Americans to care for our wild places." TWS prides itself as a partner of the Forest Service across the country, assisting in forest stewardship, promoting landscape-scale restoration projects, conducting original scientific research, and working to protect wild places on public lands. Our Northern Rockies office staff in Bozeman includes two PhD scientists, both of whom contributed content to this letter.

We recognize that the Forest Service faces an enormous challenge in drafting this plan revision. The Flathead National Forest is heavily used and highly valued, and the Forest Service's assessment should capture these uses and values, which have shifted significantly since the current plan was last revised. We attended the public field trips and reviewed the Preliminary Assessment Information compiled by the Forest Service. We appreciate the work that your team has already done, and hope you will find additional resources and approaches outlined below useful as you develop the new forest plan.

Table of Contents

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I. Introduction

The first stage of planning under the 2012 planning rule is the assessment. In this stage, the Forest Service must complete an assessment report that "identif[ies] and evaluate[s] existing information relevant to the Plan area" for each of fifteen topics. 36 C.F.R. § 219.6(b). The 2012 planning rule provides for public participation in the development of the assessment report including the submission by non-governmental entities of existing information for the assessment.[1] A main purpose of the assessment is to inform the identification of the need for change and the development of plan components.

Our submission specifically addresses several of the fifteen topics that the Forest Service is required to consider in a plan assessment[2], including:

- System drivers, including dominant ecological processes, disturbance regimes, and stressors, such as natural succession, wildland fire, invasive species, and climate change; and the ability of terrestrial and aquatic ecosystems on the plan area to adapt to change;
- Terrestrial ecosystems, aquatic ecosystems, and watersheds
- Threatened, endangered, proposed and candidate species, and potential species of conservation concern present in the plan area
- Recreation settings, opportunities and access, and scenic character
- Infrastructure, such as recreational facilities and transportation and utility corridors.
- Existing designated areas located in the plan area including wilderness and wild and scenic rivers and potential need and opportunity for additional designated areas.

We have chosen to provide input specifically on these assessment topics because The Wilderness Society has particularly relevant professional expertise and experience both generally and in the planning area on these topics.

[1] 36 CFR 219.4 requires the responsible official to provide participation opportunities: "The responsible official shall provide opportunities to the public for participating in the assessment process…" 36 CFR 219.6(a)(2) requires the responsible official to "Coordinate with or provide opportunities for…. other governmental and non-governmental parties, and the public to provide existing information for the assessment."

[2] 36 CFR 219.6(b)
36 CFR 219.6(b)(15) states, "In the assessment for plan development or revision, the responsible official shall identify and evaluate existing information relevant to the plan area for the following….(15) Existing designated areas located in the plan area including wilderness and wild and scenic rivers and potential need and opportunity for additional designated areas."

We are submitting "relevant existing information" in the form of studies and governmental reports for inclusion in the assessment report pursuant to 36 CFR 219.6(a)(1) and (2). For many categories, we provide information as well as suggest additional important types of information that are relevant to assessing current trends and developing the plan revision. For the materials cited in this letter, we have provided either copies on the accompanying CD or hyperlinks (or both) where the information can be located in the public domain. Please let us know if we can further assist the Forest Service in locating the information cited below.

We dedicate considerable space in this letter on the question of potential need and opportunity for additional designated areas[3] in the Flathead NF plan revision, given this topic's importance as a central part of our organizational mission. There is both opportunity and need for additional designations on the FNF that are based on credible scientific and social data and that will make a significant contribution to a climate-resilient Flathead NF.

Finally, we address some issues and opportunities related to the public engagement process around the plan revision that we would like the Flathead NF to consider as the plan revision proceeds, based on our experience in the early implementation of the 2012 planning rule and the Draft Directives on other national forests.

Taken together, the assessment topics suggest, as do we, that the Flathead NF needs to take a landscape-level approach to management that integrates vegetation management, fire, wildlife, aquatic species and systems, roads management, and protected areas as elements of an ecosystem that work together – and that explicitly incorporates climate change considerations and adaptive management strategies to ensure the resilience of this ecosystem long into the future. The information we are providing for the Assessment phase about current conditions and trends will support the forest in developing this approach in the future plan. We also believe that adaptive management as called for in the planning rule warrants acknowledgement that adjustments in management should occur based on monitoring and new science.

The 2012 planning rule requires the responsible official to "use the best available scientific information to inform the planning process….In doing so, the responsible official shall determine what information is the most accurate, reliable, and relevant to the issues being considered."[4] The information we used to inform this letter constitutes the best available science to our knowledge, and we ask that you consider it as such.

II. Overall Suggestions for the FNF Plan Revision's Assessment and Scientific Foundation

We suggest the following overarching considerations for, and approaches to, the plan revision to help the FNF achieve its desired outcomes under the new planning rule:

- Develop a conceptual framework to allow all stakeholders to understand exactly how all of the different components required under the new planning rule will feed into the overall, larger planning model that will be used on the FNF. We view the development of a conceptual framework for the new climate adaptation planning piece of the forest planning process as being particularly essential because this is a completely new requirement of considerable complexity under the new rule.

Commented [KR-1]: FEIS appendix 7; SFS Northern Region Adaptation Partnership

[3] 36 CFR 219.6(b)(15)
[4] 36 CFR 219.3

- Consider developing a regional synthesis of the best available science on current 'hot' topics for use in all planning processes in the region, as did the US Forest Service Pacific Northwest Research Station in the context of the new forest plan revisions of the Sierra NFs. Citizens engaged in those plan revisions have found such a synthesis to be particularly useful, and we would like to request that the Northern Region Office consider doing the same to assist the many national forests in the region who are scheduled to undertake plan revisions during the next several years. A vital part of this synthesis could also be the identification of specific targets/ wildlife species, etc. that will be prioritized at a Regional scale.

- For the same reason, and given the tremendous complexity of this particular task, we would also ask that the Regional Office establish a process for institutionalizing climate models, impacts, and datasets across the region: we believe that this would help individual national forests immeasurably and create a higher level of consistency and approach for this new and difficult part of the new planning process.

Commented [KR-2]: USFS Northern Region Adaptation Partnership

- We suggest that the creation of a framework that clarifies the ways in which all information will be evaluated and managed during the forest planning process would be valuable for agency staff and stakeholders alike, along with clear communication of the criteria used during these processes.

- We greatly appreciate the clear thinking by the FNF regarding the need to create monitoring programs to provide feedback for adaptive management moving forward across the 4-million- acre FNF. Given the extraordinary complexity of developing and implementing such a monitoring program, we would like to ask managers to be explicit about the assumptions upon which each component of the monitoring program is based, the uncertainty associated with different aspects of the draft plan, the monitoring questions to be addressed, the expected use of the data, and the establishment and use of triggers in altering management strategies and activities.

Commented [KR-3]: Monitoring guide and chapter 5 of the revised plan

III. Relevant Existing Information for Assessment Topics
Below, for each assessment topic, we provide relevant existing information.

A. System drivers, including dominant ecological processes, disturbance regimes, and stressors, such as natural succession, wildland fire, invasive species, and climate change; and the ability of terrestrial and aquatic ecosystems on the plan area to adapt to change

When assessing both the status of ecosystems and system drivers, the Forest Service is required to evaluate information about likely future threats or "stressors" during Forest Planning processes. Draft Directives, Forest Service handbook ("FSH") 1909.12, at Ch. 10, Sec. Sec. 12.15d; 12.32. (Feb 2013 Draft) (the draft directives, Ch. 10 are hereinafter referred to as "Sec. _"). In addition to evaluating these specific sources of information in the assessment topic, we also suggest the Flathead NF consider the following approaches to management that are well represented in recent and emerging peer-reviewed science.

1. Approaches to System Drivers and Climate Adaptation

<u>Portfolio Approaches and Risk Management</u>
Ongoing and future changes in climate will surely alter forest composition, structure, function, and patterns of biological diversity in the Northern Rockies and the Flathead National Forest (Prato and Fagre

2007). However, significant uncertainty remains with respect to the actual changes in climate and the manifestations those climate changes will have on ecosystems. This biophysical uncertainty is compounded by lack of clear strategies to conserve ecosystem values upon which communities depend. The IPCC (2007), Millar et al. (2007), and Aplet and Gallo (2012), among others (e.g., Heller and Zavaleta 2009, Larson et al. 2013) have suggested that a portfolio of approaches is needed in any plan for climate adaptation. Rather than adopting a single strategy to address climate change, a portfolio approach uses alternatives intentionally designed to facilitate learning and future adaptation as changes in climate and other environmental factors alter ecosystem function and services. A portfolio strategy hedges against an uncertain future, and placed with an active adaptive management framework (*sensu* Larson et al. 2013) enables science-based decisions and management adjustments in the future.

We suggest that the Flathead NF adopt a three-zone portfolio approach to climate adaptation (e.g., Aplet and Gallo 2012) wherein forests are zoned for experimentation of strategies intended to: (1) resist changes through restoration of historical conditions, (2) anticipate and innovate to guide changes intended to sustain key ecosystem processes and services, and (3) accept changes alongside monitoring and research (i.e., observation) to lead to new insights into climate-induced changes in ecosystems. Applying the three-zone portfolio approach on any forest or ranger district should be conducted so that ecological, social, and economic factors are overlaid in a spatial decision support framework.

Commented [KR-4]: See revised forest plan; terrestrial ecosystems and vegetation section of FEIS

Because of the social and scientific uncertainty concerning restoration of mixed conifer forests historically characterized by a mixed severity or stand replacing fire regime -- which dominates forest types on the Flathead NF (FNF Preliminary Assessment Information, Figure 4) -- we suggest any forest- wide vegetation management strategies adopt an active adaptive management approach to projects (Larson et al. 2013). Adopting an active adaptive management strategy coupled with a monitoring framework that clearly articulates implementation, effectiveness, and ecological effects monitoring goals should lead to more science-driven management that considered the full suite of forest values and potential tradeoffs among values (Hutto and Belote 2013).

To further explain what such a strategy would look like on the ground, we provide a regional, real-life example to illustrate the approach as described in Larson et al. 2013: the Dalton Mountain Forest Restoration and Fuels Reduction Project. For this project, managers in the Lincoln Ranger District of Montana were tasked with designing a restoration project in lodgepole pine forests near the town of Lincoln; the project was part of the Southwestern Crown of the Continent (SWCC) Collaborative Forest Landscape Restoration Project (CFLRP). The goal was to reduce fuel loads and break up fuel continuity at a landscape scale by harvesting approximately 2,000 acres across a 40,000-acre project area, and included prescribed burning on inventoried roadless acres. Conditions within the project area included extensive tree mortality from a mountain pine beetle epidemic and a lack of desired forest structure and species diversity predicted to sustain the presumed historical mixed-severity fire regime: all of which exacerbated local residents' concerns about the risk of wildfire in this area.

Given a lack of scientific and social consensus about the most effective method of achieving restoration goals in lodgepole pine forests, the Forest Service and collaborators opted to test multiple treatment types within the same project area through time. An active adaptive/ risk management approach like the one described here has the potential to be extremely useful in an era of changing climate because there will be many instances in which we may not know the best course of action needed to achieve a specific restoration objective. A risk management approach allows managers to minimize risk and maximize learning while creating real-time information feedback loops that will inform conversations with the public about future restoration projects in that particular forest type.

The active adaptive management approach described here requires the incorporation of several elements within the project design (see below map):

- *pre-treatment stand data* across the project area,
- the use of *untreated controls* within the project area,
- *more than one treatment type*,
- *replication of treatment types and controls across the project area*, and
- *unbiased assignment of treatments*.
- Stands of particular concern to residents in the event of a future fire (i.e. near existing structures, etc.) were not chosen as "Control" (i.e. untreated) units in the final design.

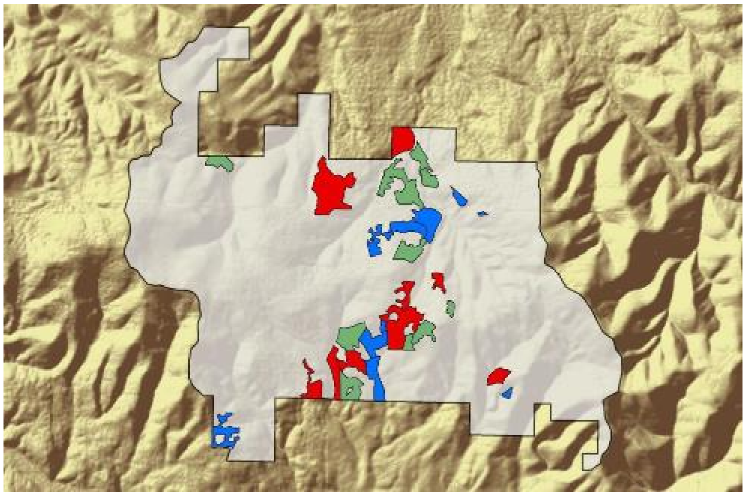

Figure 1. Dalton Mountain project area of the Southwestern Crown of the Continent Collaborative Forest Landscape Restoration Program. Treatment design for 30 stands of lodgepole pine-mixed conifer forests with high levels of mortality from bark beetles was guided by an adaptive management approach collaboratively developed by the Forest Service and Lincoln Restoration Committee in partnership with The Wilderness Society and the University of Montana. **Red**= Control units; **Blue**= Aggregated retention units; **Green**= Leave tree regeneration units. Figure courtesy of Travis Belote, TWS.

The active adaptive management approach described above can also be applied at different spatial scales across a landscape. For example, the Dalton Mountain Restoration Project occurs at the stand scale (see Figure 2 map A). A second (and, in this case, hypothetical) example might occur at the watershed scale (see Figure 2, map B). Here, managers could develop a portfolio approach to more effectively manage risk through the use of "zones" that correspond to different management strategies. That is, (1) "observation zones" – lands where the impacts of climate change and other stressors are expected to be low to moderate – could comprise areas where managers both accept and learn from climate-induced changes; (2) "restoration zones" – lands where the impacts of climate change and other stressors are expected to be moderate to high – could comprise areas where managers resist climate-induced changes by working to restore resilience to degraded lands; and (3) "innovation zones" – lands where the impacts of climate change and other stressors are expected to be extremely high- could comprise areas where managers choose to facilitate transition to novel ecosystems given expectations that these ecosystems will undergo large scale, climate-induced shifts (see below references).

In reality, of course, one cannot simply assign entire watersheds to different zones without taking into account the legal constraints of particular land designations. The SWCC CFLRP project, however, offers

the opportunity to incorporate two of these three portfolio approaches at the landscape scale: the Bob Marshall Wilderness (in red, below, Figure 2 map C) naturally forms an "observation" zone in which managers are legally required (by virtue of the provisions of the Wilderness Act) to manage this area minimally, while the SWCC CFLRP project area (outlined in black, Figure 2 map C) is a "restoration" zone in which substantial intervention by managers could help reverse environmental degradation associated with a range of historic stressors, land use, and climate change. In this way, an active adaptive management approach offers critically important opportunities to learn – through monitoring programs tied to management activities in each zone – that could directly inform management decisions moving forward.

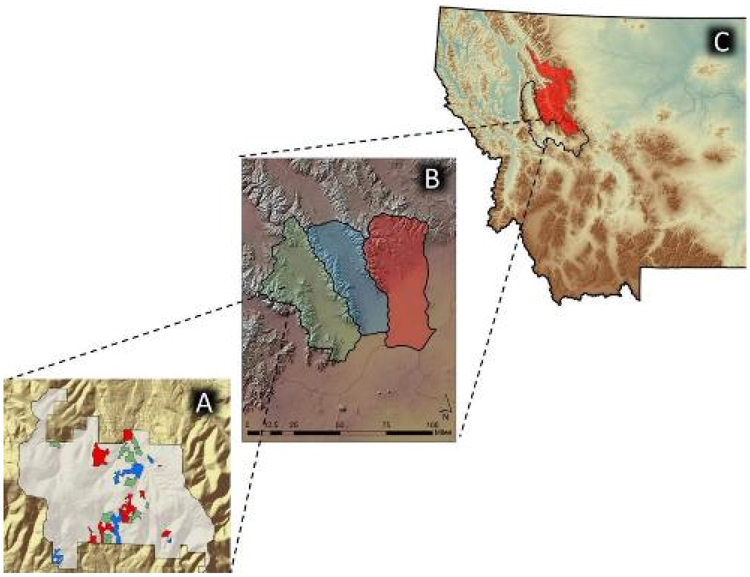

Figure 2. Application of an active adaptive management approach across different geospatial scales, e.g. from stand scales (A) as in the case of the Dalton Mountain Restoration Project; to a hypothetical example using watersheds (B); and landscapes (C), in which the Bob Marshall Wilderness is shown in red and the Southwestern Crown of the Continent is contained within the black outline. Figure by Travis Belote and used courtesy of Tabor et al., in press.

For additional case studies of on-the-ground, regional management actions used to address climate change in the Northern Rockies, the FNF should also review the new document, *Restoring Forests for the Future: Regional Example*. This reference was prepared by TWS at the request of the Montana Forest Restoration Committee (MFRC), and summarizes on-the-ground climate adaptation projects in the Northern Rockies' region that could help the Committee and its local chapters design and implement projects that more directly account for the impacts of climate change. We also believe that it will be helpful for the FNF to review these case studies to ensure that there is room in the new forest plan to develop similar projects as the FNF moves from forest planning to project planning and implementation.

- Larson, Andrew J.; Belote, R. Travis; Williamson, Matthew A.; et al. 2013. *Making Monitoring Count: Project Design for Active Adaptive Management*. Journal of Forestry 11: 348-356.
- Tabor, Gary; Carlson, Anne A.; Belote, R. Travis. (In press). *Challenges and opportunities for large-landscape-scale management in a shifting climate: The importance of nested*

adaptation responses across geospatial and temporal scales. Forest Service Technical report.

- Larson, Andrew J., Belote, R. Travis, Cansler, C. Akina, Oarks, Sean A., and Dietz, Matthew S. *Latent resilience in ponderosa pine forest: effects of resumed frequent fire*. Ecological Applications 23: 1243-1249;
- Gallo, John, and Aplet, Greg. 2012. Portfolio approach paper;
- Kujala, Heini, Burgman, Mark A., and Moilanen, Att. 2013. *Treatment of uncertainty in conservation under climate change*. Conservation Letters 6: 73-85.
- Millar, Constance I.; Stephenson, Nathan L., and Stephens, Scott L. 2007. *Climate change and forests of the future: managing in the face of uncertainty*. Ecological Applications 17: 2145-2151.
- Aplet, Greg; and Gallo, John. 2012. Applying climate adaptation concepts to the landscape scale: examples from the Sierra and Stanislaus National Forests. The Wilderness Society (wilderness.org).
- Cross, Molly S., McCarthy, Patrick D., Garfin, Gregg, Gori, David, and Enquist, Carolyn A.F. 2012. *Accelerating adaptation of natural resource management to address climate change*. Conservation Biology 27: 4-13.
- Lawler, J.J., Spencer, B., Olden, J.D., Kim, S-.H., Lowe, C., Bolton, S., Beamon, B.M., Thompson, L., and Voss, J.G. 2013. *Mitigation and adaptation strategies to reduce climate vulnerabilities and maintain ecosystem services*. Climate Vulnerability 1: 315-335. This comprehensive reference document describes numerous mitigation and adaptation strategies designed to help public lands managers maintain crucial ecosystems services as the climate continues to change.
- Carlson, Anne A. 2013. *Restoring Forests for the Future: Regional Examples*. Montana Forest Restoration Committee.

Commented [rk5]: ACK, PC See revised forest plan; terrestrial ecosystems and vegetation section of FEIS

Commented [rk6]: ACK, PC See revised forest plan; terrestrial ecosystems and vegetation section of FEIS

Commented [rk7]: ACK PC See FEIS; FEIS appendix 7

2. Planning and Modeling Tools for System Drivers and Climate Adaptation

Managing for Historic Range of Variability (HRV) While Preparing Forests for Ongoing Climate Change: Another significant challenge of managing public forests as the climate continues to change is the movement of ecosystem and disturbance processes in a particular landscape out of a Historic Range of Variability (HRV) to an unknown Future Range of Variability (FRV). To address this challenge, Dr. Paul Hessburg and his colleagues at the Wenatchee Forestry Science Laboratory in Wenatchee, Washington, have conducted landscape assessments and developed methods for comparing historical landscape conditions with contemporary conditions at the landscape scale; a significant portion of this study was conducted on the Flathead National Forest of Montana (Hessburg et al. 2000a). Through the use of photo-interpretations of vegetation composition, forest structure, patch size distributions and arrangement, and other landscape-level characteristics, he and his team have been able to establish the degree to which forests have departed from historical conditions. Building on this framework, they have developed new tools for assessing how existing forest conditions are outside of both the historic and future ranges of variability (Hessburg et al. 2013). They create a 'best estimate' of future ranges of variability by sampling watersheds with climate regimes similar to future climate change scenarios predicted for that area. In other words, they use current climate-ecological relationships across existing climate gradients as analogues for future climate change. In this way, Dr. Hessburg and his colleagues have developed methods for determining which characteristics of the forest may need to be treated to both restore historic range of variability while simultaneously preparing those forests for climate change. Using the Ecosystem Management Decision Support (EMDS) tool, Hessburg et al. can incorporate not only vegetation, but also fire risk, wildlife habitat, aquatic conditions, timber resources, and other values that can be mapped onto landscapes into their models (Hessburg et al. 2013). As the climate continues

to change, the question, "Restore to what?" will become more and more challenging for managers. Tools and methodologies like the ones described here offer an opportunity to define the answer to this question in a powerful and defensible new way.

Please consider contacting Dr. Hessburg, as much of the analysis for the Flathead National Forest is already complete. We are also willing to help conduct additional analyses in collaboration with Dr. Hessburg to help develop demonstration projects using this approach on the Flathead National Forest.

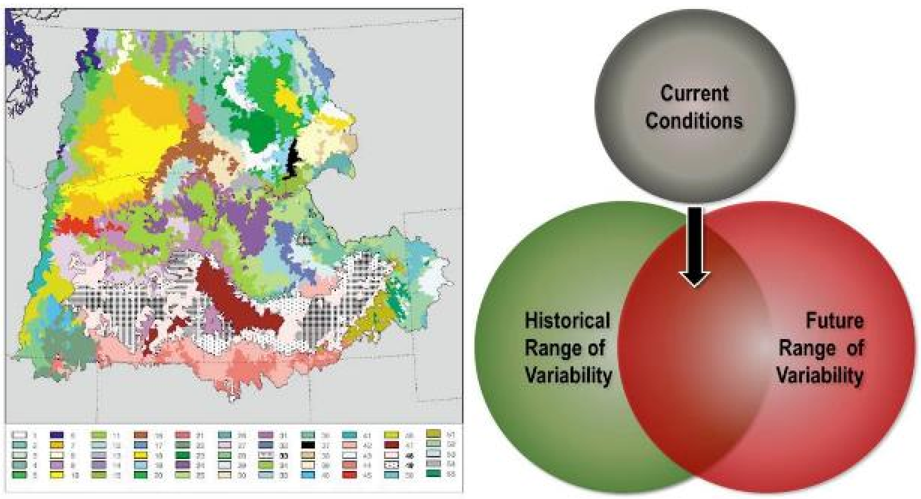

Figure 3. Map on the left shows ecological regions classified based on similar climate, geology, and landform characteristics developed by Hessburg et al. (2000b). Different colors represent different ecological regions of the interior Columbia River Basin including much of the Flathead National Forest. The figure to the right illustrates conceptually the processes of evaluating departure from a historical range of variability while also including an assessment of departure from 'future range of variability.' Each circle represents the quantification of many characteristics of a forest landscape. Future ranges of variability are assessed using characteristics of ecological regions that currently experience climatic regimes predicted for another given ecological region. For example a given ecoregion may be expected to experience a warmer and drier climate in the future. In this case, a warmer and drier ecological region that currently exists on similar landforms can be used to predict how climate governs forest composition, landscape characteristics, and species composition. Because these analogues often share characteristics with historical ranges of landscape characteristics, the multiple shared characteristics can be used as a management guide to assess and attempt to move landscape conditions toward historical conditions while preparing for climate change (shown as black arrow).

- Hessburg, Paul, F., Reynolds, Keith M., Salter, R. Brion, Dickinson, James D., Gaines, William L., and Harrod, Richy J. 2013. *Landscape evaluation for restoration planning on the Okanagan-Wenatchee National Forest, USA*. Sustainability 5: 805-840.

Commented [rk8]: ACK; but used Hessburg publications specific to the Forest as well as Columbia River Basin; see FEIS appendices 2 and 3

Landscape Models and Stand-level Fire Histories to Assess Natural Range of Variability

The Flathead NF should consider leveraging a combination of landscape models and stand fire histories when assessing natural range of variability. We are aware of ongoing science conducted by the Rocky Mountain Research Station's Missoula Fire Sciences lab that would help inform forest vegetation and fire management on the Flathead National Forest. Specifically, Dr. Elaine Sutherland and David Wright have been conducting stand level fire histories across landscapes located in the vicinity of the Flathead National Forest, including the Coram Experimental Forest and other nearby areas. Dr. Rachel Loehman

has been working with a landscape fire model (FireBGCv2) that is capable of incorporating multiple characteristics of forest composition and structure, vegetation treatments, wildlife habitat suitability, carbon storage, and climate change. Dr. Loehman is currently working on a project investigating how climate change, fuels treatment, and wildfire may influence lynx habitat on a large portion of the Flathead National Forest.

Dr. Andrew Larson at the University of Montana is also a locally-stationed expert on the importance of within-stand variability in conifer forests of the interior northwest. Dr. Larson has written several seminal scientific articles on the subject of how the spatial arrangement of trees within stands should be an important part of restoration or other forest harvesting treatments (Larson and Churchill 2012; Churchill et al. 2013).

Incorporation of climate scenarios into Forest Service planning tools, i.e. Climate Forest Vegetation Simulator (FVS)

In addition to Dr. Hessburg's methodology of considering climate change into forest planning, another crucial component of developing effective restoration projects in an era of shifting climate is likely to be the incorporation of different climate change scenarios into project planning tools. In recent years, Forest Service staff from the Moscow, Idaho office have addressed this need in two phases. First, Nicholas Crookston, Gerald Rehfeldt and their colleagues used three different climate scenarios (B1, A1B, and A2) to model expected changes to the distribution of 90 different North American tree species through the 21st century. Next, Crookston and his colleagues incorporated regional climate-based predictions for different tree species into a widely used Forest Service planning tool, Forest Vegetation Simulator (FVS). Through this work, managers are now able to consider the effects of different climate scenarios on growth and mortality rates at local scales. While there are some significant concerns with applying continental and regionally developed models to local stand processes, these tools at least allow managers to consider how changes in climate may be expressed at local scales as species respond physiologically and demographically to new climate conditions.

Additionally, in 2012, the University of Idaho began an in-depth, multi-year study of the application and use of Climate FVS through a $3.2 million National Science Foundation grant. Their efforts included multiple workshops throughout the Northern Rockies region to test this new approach, including a November, 2012 workshop held in Missoula, Montana in which many Forest Service staff from Montana participated (see list of attendees on the University of Idaho website, below). All of the training materials and video-taped sessions of these workshops are available for download on this website as well.

- Scientific publications explaining the methodology, assumptions and types of uncertainty associated with these models, etc.: Rehfeldt, Gerald E., Crookston, Nicholas, L., Warwell, Marcus V., and Evans, Jeffrey S. 2006. *Empirical analyses of plant-climate relationships for the western United States*. International Journal of Plant Sciences 167: 1123-1150.
- Climate change scenarios for specific tree species generated by this group of Forest Service employees.
- Website for Nicholas Crookston's lab (with access to relevant datasets).
- Rehfeldt, Gerald E., Crookston, Nicholas L., Warwell, Marcus V., and Evans, Jeffrey S. 2006. *Empirical analysis of plant-climate relationships for the Western United States*. International Journal of Plant Sciences 167: 1123-1150.

Commented [KR-9]: ACK FVS used at project level

Models to Inform Carbon Management

The FNF's Preliminary Assessment Information states that "wildfires and insect outbreaks can release large amounts of carbon to the atmosphere (short- and long-term) and reduce carbon stocks." The long-term balance between loss of carbon from fire and the accumulation of carbon through forest aggradation is complex and depends on potential site productivity, regional and local climate,

accumulation of charcoal (Deluca and Archer 2009), and density of regenerating trees (Kashian et al. 2006). Climate models predict a stable or slightly decreasing net primary productivity in ecoregions that cover much of the FNF (Running, unpublished data), and the interaction between vegetation growth, climate change, long-term storage in soils, fire and timber harvesting should be considered if managing to maintain carbon stores. We suggest reaching out to scientists in the region capable of running sophisticated models that incorporate this complexity. Drs. Rachel Loehman and Bob Keane at the Fire Lab, and Dr. Steve Running at the University of Montana are all well positioned to help inform carbon management strategies under a changing climate with potentially new fire regimes. We also believe that managing for a single value without consideration for possible tradeoffs between carbon management and biodiversity maintenance should be carefully considered (Bradford and D'Amato 2012). A robust active adaptive management strategy (Larson et al. 2013) tied to rigorous monitoring may provide the best pathway toward sustainable management of multiple forest values.

Commented [KR-10]: ACK See FEIS section on carbon sequestration

3. Data Resources on System Drivers, Ecological Processes, Climate Impacts; and to Inform Adaptive Management

We suggest the following data sources be considered when assessing likely levels of future disturbance associated with climate change during the planning period:

- Montana drought and climate data: Historical drought trends, recent changes correlated with climate influences, and projected changes and efforts to plan for projected future impacts related to climate change are relevant to understanding the role of water resources in the landscape and anticipating effects of perturbation See Sec. 12.23. To address this portion of the 2012 Forest Planning Rule, we suggest using the extensive datasets and models available through the Northwest Climate Science Center (Northwest CSC) located at Oregon State University. Established in 2010 by the Department of the Interior to address the challenges presented by climate change in the Northwestern United States (which includes western Montana), the Northwest CSC is a federally led collaborative effort comprised of world-class climate scientists such as Dr. Gustavo Bisbal and Dr. Phillip Mote. The current focus of the program will meet the direct needs of the Flathead National Forest during the iterative processes required to consider and incorporate the best available climate change models, data into forest management. Specifically, the Northwest CSC is working to:
  - o Develop state-of-the-art climate modeling using a variety of modeling and statistical approaches to global and regional climate modeling,
  - o Use ten global and regional climate models to develop downscaled climate models for the region,
  - o Develop downscaled hydrology models using two different socioeconomic scenarios for each of the ten global climate models, and
  - o Carefully quantify uncertainty and utilization of the regional models for managers to facilitate the appropriate use of this information.

Commented [KR-11]: See FEIS discussion of climate models

- Crown Managers Partnership landscape-scale monitoring datasets: The Crown Managers Partnership (CMP) consists of 20+ state, federal, and provincial agencies from the United States and Canada that collectively manage public lands across the 18-million-acre Crown of the Continent. Formed in 2001, the CMP seeks to address numerous environmental management challenges in the Crown region by adopting transboundary, science-based approaches for this large, complex region. Among other goals, the partnership works to develop collaborative, complementary tasks that the various participating jurisdictions can pursue together across the

Crown: to date, this includes sharing data across agencies and jurisdictions, leading to standardized assessment and monitoring methodologies.

In recent years, the CMP has worked intensively to develop an Ecological Health Indicators Project, which may have tremendous value for multiple Forest Restoration Committees in Montana that choose to coordinate with the CMP. Specifically, the CMP recognizes that the jurisdictional complexity of the Crown has led to numerous independent initiatives to monitoring ecological health, despite the fact that many of the stresses and challenges facing Crown managers are similar and likely will require coordination beyond jurisdictional boundaries. In an effort to coordinate evaluations of the condition and patterns of change and at the scale of the Crown, and to address the urgent need to understand the impacts of climate change given its
role as a driver that affects all indicators, the CMP initiated the Health Ecological Health Indicators Project.

The Ecological Health Indicators Project has developed credible science-based approaches for identifying the current condition of indicators (baseline) and for tracking changes over time (trends). Integrating and synthesizing existing geospatial data to create a set of seamless base maps for the Crown was a primary objective of this project from the start, and has occurred over the course of the last several years with funding and support from the Great Northern Landscape Conservation Cooperative and other funders. These base maps can be used to assess the ecological status of the Crown Ecosystem circa 2000 and will allow the detection and assessment of subsequent landscape change due to multiple stressors – including climate change. To date, baseline maps have been completed for roads, population density, dwelling density, streams, watersheds, landcover, fire and insects.

By coordinating with CMP members, the Flathead National Forest has the opportunity to tap into the results of expensive, long-term monitoring programs across a much larger landscape to
access key information during the planning and implementation stages of specific forest projects at more local scales.

Commented [KR-12]: ACK FNF participates in CMP

Data products of the Ecological Health Indicators Project are contained within the CMP's geospatial library and include error-checked, corrected datasets on the following:

o Roads
o Geographic administration (e.g. census)
o Hydrology (riparian areas, stream/ road intersections, streams/rivers, and watershed boundaries)
o Land features (ecoregions, landcover, phenology)
o Natural disturbance (fire histories, insect infestations)

- Results from the Assisted Migration Adaptation Trial (AMAT): Nearly a decade ago, research scientists in the Forest Genetics Section of the British Columbia (B.C.) Ministry of Forests, Lands and Natural Resource Operations identified a critical need to understand the impacts of a shifting climate on their large-scale tree planting programs throughout the forests of British Columbia. Specifically, each year the Ministry plants approximately 200 million tree seedlings. When those trees are harvested 60-80 years from now, however, the climate is expected to be 3-4 degrees warmer than when the seedlings were put into the ground, potentially exposing the trees to numerous impacts from a warmer climate (e.g. slower growth, increased mortality due to drought, insect outbreaks, pathogens, etc.). In an effort to better understand these potential impacts and generate an information-based process to revise current seed source guidelines for planting programs, researchers initiated a long-term climate change study in 2006 to better

understand the climatic tolerances of specific tree species across western Canada and the United States; the experiment will conclude in 2020, although results are available throughout the study.

Specifically, seedlings from multiple seed stocks of 15 native western North American tree species were planted at 48 different sites from northern California to the southern Yukon between 2009 and 2012, spanning a wide range of climatic conditions and latitudinal ranges.
Tree species included in this long-term, climate change experiment include: (1) Amabilis fir (*Abies amabilis*); (2) Grand fir (*Abies grandis*); (3) Sub-alpine fir (*Abies lasiocarpa*); (4) Paper birch (*Betula papyrifera*); (5) Yellow cypress (*Callitropsis nootkatensis*); (6) Western larch (*Larix occidentalis*); (7) Interior spruce (*Picea glauca ×P. engelmannii*); (8) Sitka spruce (*Picea sitchensis*); (9) Lodgepole pine (*Pinus contorta*); (10) Western white pine (*Pinus monticola*); (11) Ponderosa pine (*Pinus ponderosa*); (12) Trembling aspen (*Populus tremuloides*); (13) Douglas fir (*Pseudotsuga menziesii*); (14) Western red cedar (*Thuja plicata*); and (15) Western hemlock (*Tsuga heterophylla*).

Seedlings were planted at sites warmer and colder, wetter and drier, and further North and further South than the origin of their seed stock, with detailed health and growth assessments for each tree recorded every five years (beginning at age five). Simultaneous collection of weather conditions at all planting sites is enabling Ministry researchers to develop a detailed understanding of the response of different seed stocks to varying climatic conditions, and to develop more accurate models for predicting which tree populations are most likely to be productive and healthy five years from now. Results from this study will inform planned changes to the Climate-Based Seed Transfer System by identifying seed sources most likely to be adapted to current and future climates, and has implications for both timber companies and public land agencies alike (dozens of whom have partnered with the Ministry on this ground-breaking project). By tapping into this growing knowledge base, the Flathead National Forest could significantly increase its chances of achieving restoration objectives associated with projects that include re-planting activities, which may help managers retain highly-valued tree species across the landscape, and affect the density, size, and overall health of trees within our forests.

- Pedlar, John H.; McKenney, Daniel W.; Aubin, Isabelle; et al. 2012. *Placing Forestry in the Assisted Migration Debate*. BioScience 62: 835-842.
- Wang, T., E.M. Campbell, G.A. O'Neill, and S.N. Aitken. 2012. *Projecting future distributions of ecosystem climate niches: Uncertainties and management applications*. Forest Ecology and Management 279:128-140.

Commented [rk13]: ACK See FEIS; Northern Region Adaptation Partnership

Information Resources on the Flathead NF in a Landscape Context

In addition to looking both forward and backward, the assessment process must also look both inward - to the national forest lands themselves – and outward – to the broader landscape. The draft directives emphasize the importance of broad ecological scales and landscape context:

"The goal of evaluating information about ecosystem integrity at scales broader than the plan area is to understand the context of management for resources within the plan area. An understanding of the environmental context extending beyond the plan area should be useful in determining opportunities or limitations for NSF lands to contribute to the sustainability of the broader ecological systems, as well as the impacts of the broader landscape on the sustainability of resources within the plan area." Sec. 12.13; see also Sec. 12.14, 12.15. Accordingly, the Forest Service should consider ecosystem functions which cross forest boundaries; landscape patch adjacency and context, connectivity, and compatibility of nearby land uses; and the geographic ranges and habitats of at-risk species within and near the plan area." *Id*. At Sec. 12.13, 12.14, 12.15d.

The following information is relevant to landscape-scale linkages provided by the National Forest and impacts of land use on surrounding lands on National Forest lands:

- U.S. Dept. of Agriculture, Forest Service, *National Forests on the Edge: Development Pressures on Amer ica's National For est s and Gr ass lands* . This Forest Service publication shows that the Flathead National Forest is in the moderate category for developmental pressures.

Commented [kmg14]: ACK

- U.S. Dept. of Agriculture, Forest Service, *Effects of Climatic Variability and Change on Forest Ecosystems: A Comprehensive Science Synthesis for the U.S. Forest Sector* (Dec. 2012). This report concludes, among other things, that promoting landscape connectivity can enhance the forest's resilience to climate change.

Commented [rk15]: ACK. See FEIS section 3.7.6

- U.S. Dept. of Agriculture, Forest Service, *Climate Change Considerations in Land Management Plan Revisions* (Jan. 2010). This Forest Service guidance instructs planning units to consider the risks of climate change and incorporate mitigation strategies into plan direction.

B. **Terrestrial ecosystems, aquatic ecosystems, and watersheds**

Relevant Existing Information on Aquatic Ecosystems and Watersheds

- Data from the USDA Forest Service Natural Resource Manager, including data on water uses, watershed condition, infrastructure, non-motorized water uses, and fishing data.

Commented [kmg16]: AP, PC ACK

- The Forest Service's Fo rests t o Faucet 's assessm ent , showing land areas most important to surface drinking water, and providing importance rankings for the Flathead National Forest region.

Commented [kmg17]: AP PC

- U.S. Environmental Protection Agency, *L iquid Assets: Amer ica's W ater Res our ces at a T ur ning Point* (2000), describing the economic benefits of clean water and health, social, and economic costs of polluted water.

Commented [kmg18]: ACK FEIS section 3.2

- Alexander, R.B., Boyer, E.W., Smith, R.A., Schwarz, G.E., and Moore, R.B. 2007. *The role of headwater streams in downstream water quality*. JAWRA Journal of the American Water Resources Association 43: 41-59. This paper investigates watershed research and modeling to assess headwater influences on downstream receiving waters, concluding headwater areas have a "profound influence" on shaping downstream water quantity and quality.

Commented [kmg19]: ACK FEIS section 3.2

- Meyer, Judy L., Strayer, David L., Wallace, J. Bruce, Eggert, Sue L., Helfman, Gene S., and Leonard, Norman E. 2007. *The contribution of headwater streams to biodiversity in river networks*. JAWRA Journal of the American Water Resources Association 43: 86-103. This paper concludes that "the biological integrity of entire river networks may be greatly dependent on the individual and cumulative impacts occurring in the many small streams that constitute their headwaters."

Relevant Existing Information on Aquatic Ecosystems and Watersheds in the Flathead NF

Improving terrestrial and aquatic connectivity at the watershed scale: Tools for prioritizing and monitoring aquatic restoration projects: A primary objective of the Collaborative Forest Landscape Conservation Program (CFLRP), in which the Flathead National Forest actively participates, is to "maintain or improve water quality and watershed function" and fisheries habitat, a mandate directly related to another primary objective of CFLR, which is to remove unnecessary roads from the Forest Service landscape. Given the tremendous challenges associated with this Forest Service directive for all Forests (and not just those involved in CFLRP's), we include here information about new tools that may make this work more feasible for Forests in the future. Specifically, there are many difficulties associated with developing methods for (a) identifying those roads that negatively impact nearby streams as a means of

prioritizing future restoration projects, and (b) monitoring the effectiveness of restoration treatments post-treatment, which include the following:

- o Monitoring related to water quality and watershed integrity at the landscape scale can be complicated by natural inter-annual climatic, hydrologic, and disturbance-driven variability, as well as a range of ecological, geologic, and geomorphologic conditions,
- o Difficulties associated with measurement error,
- o A poor understanding of the ways in which roads influence stream processes across a diversity of ecosystem types and geologies,
- o Considerations of impacts associated with climate change, and
- o The high costs of data collection coupled with limited funding.

To address these challenges and test new approaches, the Aquatics Monitoring Committee of the SWCC CFLRP first created partnerships with multiple agencies concerned with the same issues from across the Western United States (i.e. U.S. Forest Service; U.S. Forest Service Rocky Mountain Research Station and National Aquatic Monitoring Program; U.S. Geological Survey Northern Rocky Mountain Science Center; Montana Fish, Wildlife & Parks; the Great Northern Landscape Conservation Cooperative; the University of Montana and several NGO's including the Clearwater Resource Council and The Wilderness Society). After a thorough evaluation of available tools and methodology by 25 agency experts in multiple workshops, two U.S. Forest Service tools were chosen for testing and implementation: (a) the Geomorphic Road Analysis and Inventory Package (GRAIP), a road inventory and monitoring protocol (see reference documents 1 and 2, here), and (b) the Pacfish Infish Biological Opinion Effectiveness Monitoring Program (PIBO), which measures stream responses to watershed management actions.

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Both tools have a strong scientific basis, excellent and widely-vetted quality control, and wide application in the region. During the first workshop, however, managers expressed evidence-based concerns that it would be very difficult to detect the effects of watershed and road restoration in downstream channels within the time frame of the SWCC project (2010-2020). For these reasons, the group decided that both GRAIP and PIBO were the right tools to address management needs, provided that they were integrated in a nested fashion within sites and effectively adopted by the SWCC. The final plan included:

- o Creating "Hybrid PIBO" methodology that dramatically increases the temporal and spatial replication across sub-watersheds,
- o Using Hybrid PIBO to develop a statistical model of the relationship between roads and in-channel stream conditions to quantify the general influence of roads in the SWCC landscape,
- o Utilizing GRAIP as a measure of watershed disruption upstream from PIBO sites (calibrated by erosion plots that were installed in 2012) rather than the more traditional measures of road density,
- o Incorporating a general design based on four focal watersheds (6th HUC) distributed across the 1.5 million acres of the SWCC, with 15-20 sites in each watershed for a total of 60-80 sites.
- o The choice of the four demonstration watersheds for this project included Cottonwood-Shanley and Morrell Creek in the Seeley Lake Ranger District, Poorman in the Lincoln Ranger District, and Jim Creek in the Swan Ranger District of the Flathead National Forest, with implementation occurring in 2012 and 2013. This integrated approach builds on state-of-the-art inventory and monitoring protocols and also incorporates key information about climate change effects to watersheds and fisheries to help better inform prioritization of limited management resources.

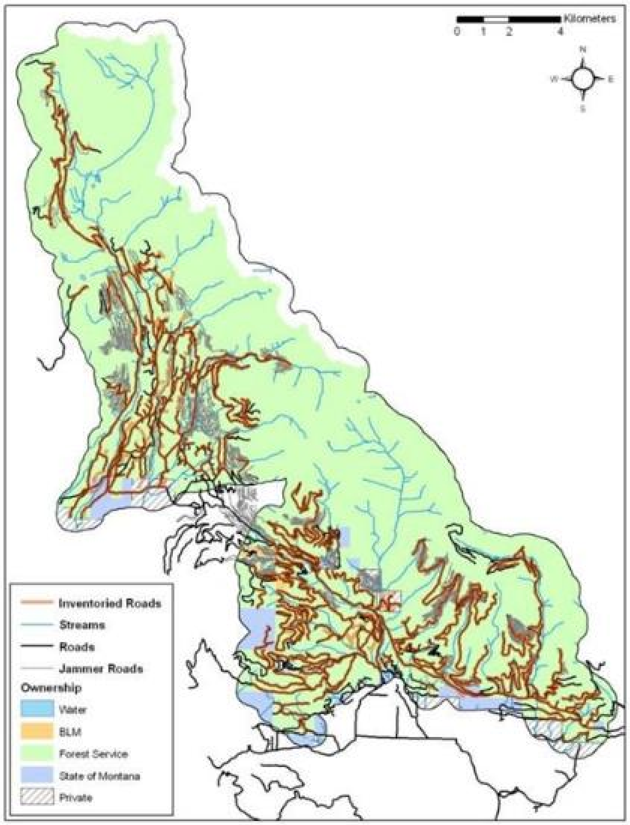

Figure 4. Example of application of the aquatic/terrestrial tools described above to National Forest lands in Montana: Land ownership and all roads within the Center Horse and Morrell-Trail project area in Seeley Lake, Montana. The two project sites include 253 miles of roads, and an additional 250 miles of jammer roads. The watershed boundary is buffered by 500 m (1640ft). Map and data analyses courtesy of Tom Black and Richard Cissel.

The first two test watersheds were located in the Center Horse and Morrell Trail project areas of the Seeley Lake Ranger District. Over the course of four months of field work by two field crews, a total of 5,061 drain points were inventoried (including 33 gullies, 18 landslides, and 844 photo points). GRAIP inventory and data modeling tools were used to characterize the following types of impacts and risks: road-stream hydrologic connectivity, fine sediment production and downstream sediment accumulation, shallow landslide risk, stream crossing failure risk, and drain point condition.

“In the Center Horse and Morrell Trail project areas, 10.2 miles out of 252 miles of inventoried road were hydrologically connected to the stream network. The bulk of the hydrologic connectivity occurred at stream crossings and broad-based dips.” With such detailed information, managers are far more able to make strategic decisions about the prioritization of restoration projects and dollars in fiscally challenging times, and to change the tenor of the often polarized discussions with the general public about the removal or restoration of specific roads. Finally, use of these monitoring tools enables managers to learn more rapidly about the effectiveness of specific restoration treatments.

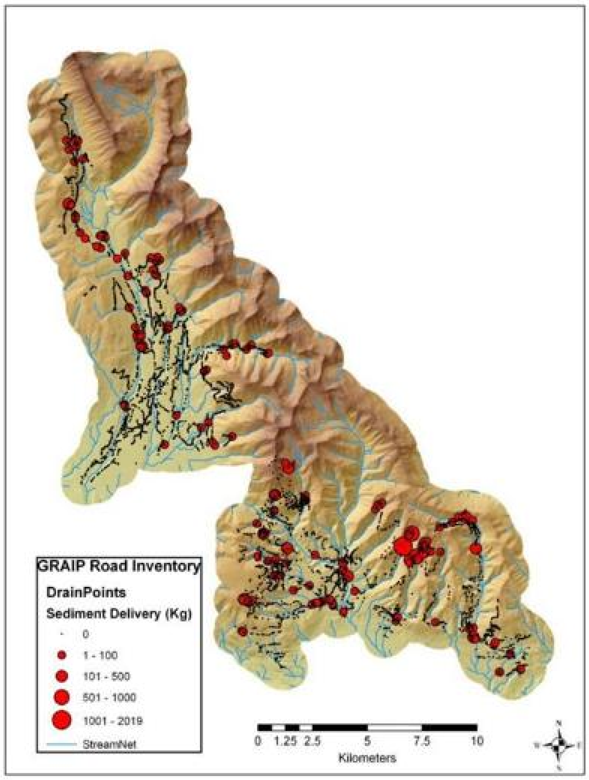

Figure 5. Initial results of the GRAIP road inventory for roads within the Center Horse and Morrell-Trail project area, with points of sediment delivery marked with red circles; the size of the red circle corresponds to the amount of sediment delivered to nearby streams annually. Rates of sedimentation for the area were derived from data collected from eight erosion plots in the Seeley Lake Ranger District over the course of two years. Data collection, data analyses, and figure courtesy of Tom Black and Richard Cissel.

C. Threatened, endangered, proposed and candidate species, and potential species of conservation concern present in the plan area

We include information on recent science on the following wildlife and aquatic species because they are species that will warrant focused attention based on the criteria laid out for wildlife in the FNF's pre-Assessment information. All of the studies below focus on either the basic biological needs of species, known management impacts on these species that the FNF might want to consider, or the potential impacts of a changing climate on these species' viability.

1. Pileated woodpeckers

- Cooke, H.A. and S.J. Hannon. 2012. *Nest-site selection by old boreal forest cavity excavators as a basis for structural retention guidelines in spatially-aggregated harvests*. Forest Ecology and Management 269: 37-51. This paper highlights the importance of

Commented [rk21]: CON. Need for restoration of decid. Trees recognized in assessment, revised plan, FEIS section 3.7.4.

retaining large diameter, tall, living aspen for pileated woodpeckers and species that depend on old growth forests.

- Edworthy, A.B.; Drever, M.C.; and K. Martin. 2011. *Woodpeckers increase in abundance but maintain fecundity in response to an outbreak of mountain pine bark beetles*. Forest Ecology and Management 261: 203-210. This paper shows that mountain pine beetle infestations lead to temporary increases in woodpecker population densities but do not alter woodpecker fecundity. In short, more woodpeckers move into an area if there is an increase in food resources but reproductive success for these birds does not change.
- McClelland, B.R. and P.T. McClelland. 1999. *Pileated woodpecker nest and roost trees in Montana: links with old-growth and forest "health"*. Wildlife Society Bulletin 27: 846-857. This paper discusses the importance of old growth forests for maintaining pileated woodpecker populations given that old growth larch forests have higher numbers of dead and decaying trees, which provide high quality nesting habitat.

2. Hairy woodpeckers

- Straus, M.A.; Bavrlic, K; Nol, E.; et al. 2011. *Reproductive success of cavity-nesting birds in partially harvested woodlots*. Canadian Journal of Forest Research 41: 1004-1017. This paper demonstrates the importance of retaining trees for cavity nesters during timber harvests.

3. Black-backed woodpeckers

- Dudley, J.G.; Saab, V.A., and J.P. Hollenbeck. 2012. *Foraging-habitat selection of black-backed woodpeckers in forest burns of southwestern Idaho*. Condor 114: 348-357.
- Nappi, A. and P. Drapeau. 2011. *Pre-fire forest conditions and fire severity as determinants of the quality of burned forests for deadwood-dependent species: the case of the black-backed woodpecker*. Canadian Journal of Forest Research 41: 994-1003.
- Both of the above articles highlight the importance of retaining dense stands of burned trees during post-fire salvage logging operations or other forest management activities in order to provide adequate black-backed woodpecker foraging habitat.

4. Northern goshawks

- Wiens, J.D.; Noon, B.R.; and R.T. Reynolds. 2006. *Post-fledging survival of northern goshawks: The importance of prey abundance, weather, and dispersal*. Ecological Applications 16: 406-418.
- McGrath, M.T.; DeStefano S.; Riggs, R.A., et al. 2003. *Spatially explicit influences on northern goshawk nesting habitat in the interior Pacific Northwest*. Wildlife Monographs 154: 1-63
- Lehikoinen, A.; Linden, A.; Byholm, P.; et al. 2013. *Impact of climate change and prey abundance on nesting success of a top predator, the goshawk*. Oecologia 117: 283-293.
- The above papers provide insights into how climate change may impact northern goshawk reproductive success, which has important implications for managers charged with maintaining goshawk populations.

5. Trumpeter swans

- Schmidt, J.H.; Lindberg, M.S.; Devin. S;. et al. 2011. *Season length influences breeding range dynamics of trumpeter swans Cygnus buccinator*. Wildlife Biology 17: 364-372. This paper shows a positive relationship between season length and trumpeter swan habitat occupancy and breeding season in Alaska. The authors predict that warming temperatures (and thus more ice-free days) will lead to increases in suitable swan habitat and thus populations.

6. Boreal toads

- Hossack, B.R.; Lowe, W.H.; and P.S. Corn. 2013. *Rapid Increases and Time-Lagged Declines in Amphibian Occupancy after Wildfire*. Conservation Biology 27: 219-228. This

Commented [rk22]: ACK FEIS section 3.7.4

Commented [rk23]: AP, PC, FEIS section 3.7.4

Commented [rk24]: AP, PC

Commented [rk25]: ACK, AP, PC, FEIS used Dudley 2007

Commented [rk26]: ACK, AP, PC, FEIS used Nappi 2009

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Commented [rk29]: ACK

Commented [KR-30]: PC for goshawks and their habitat

Commented [rk31]: IRR. AK, Valley-bottom species does not occur on NFS lands

Commented [rk32]: CON FEIS section 3.7.4 ; used local Glacier Park study

paper documents a positive response to wildfire in boreal toad populations and reinforces the importance of maintaining natural disturbances on the landscape.

- Goates, M.C.; Hatcha, K.A.; and D.L. Eggett. 2007. *The need to ground truth 30.5 m buffers: A case study of the boreal toad (Bufo boreas)*. Biological Conservation 138: 474-483. This paper highlights several shortcomings associated with assigning a standard buffer to protect aquatic and semi-aquatic species and emphasizes the importance of ground-truthing areas before initiating management actions.
- Corn, P.S. 2003. *Amphibian breeding and climate change: Importance of snow in the mountains*. Conservation Biology 17: 622-625. This paper demonstrates how the boreal toad breeding season is linked to springtime precipitation and temperature as well as mountain snow accumulation – three factors that are predicted to change dramatically in future years.

7. Long-toed salamanders

- Hossack, B.R.; Lowe, W.H.; and P.S. Corn. 2013. *Rapid Increases and Time-Lagged Declines in Amphibian Occupancy after Wildfire*. Conservation Biology 27: 219-228.This research shows that the impacts of severe wildfire on some amphibian populations (long- toed salamanders) in the North Fork of the Flathead Valley are much more detrimental in roaded landscapes where salvage harvesting has occurred. Please consider incorporating these types of organisms in your monitoring plans to detect ecological impacts of vegetation treatments (including post-fire salvage) and road construction.

8. Canada lynx

- Carnivore surveys (on Canada lynx, fisher, wolverine, and pine marten) conducted by Forest Service biologists from the Wildlife Monitoring Committee of the Southwestern Crown of the Continent Collaborative Forest Landscape Restoration Project between 2011 and 2014 across the Swan, Seeley Lake, and Lincoln Ranger Districts. For datasets and summaries, please contact Carly Lewis (US Forest Service) and Scott Tomson (US Forest Service).
- Gonzalez, Patrick, Neilson, Ronald, P., MacKelvey, Kevin S., Lenihan, James M., and Drapek, Raymond J. 2007. *Potential impacts of climate change on habitat and conservation priority areas for Lynx canadensis* (Canada lynx). Report to: Watershed, Fish, Wildlife, Air, and Rare Plants Staff; National Forest System; Forest Service; U.S. Department of Agriculture; Washington, DC and: NatureServe, Arlington, VA.

9. Fisher

- Carnivore surveys (on Canada lynx, fisher, wolverine, and pine marten) conducted by Forest Service biologists from the Wildlife Monitoring Committee of the Southwestern Crown of the Continent Collaborative Forest Landscape Restoration Project between 2011 and 2014 across the Swan, Seeley Lake, and Lincoln Ranger Districts. For datasets and summaries, please contact Carly Lewis (US Forest Service) and Scott Tomson (US Forest Service).
- Zielinski, William J., Thompson, Craig M., Purcell, Kathryn L., and Garner, James D. 2013. *An assessment of fisher (Pekania pennanti) tolerance to forest management intensity on the landscape*. Forest Ecology and Management, in press.

10. Pine marten

- Carnivore surveys (on Canada lynx, fisher, wolverine, and pine marten) conducted by Forest Service biologists from the Wildlife Monitoring Committee of the Southwestern Crown of the Continent Collaborative Forest Landscape Restoration Project between 2011 and 2014 across the Swan, Seeley Lake, and Lincoln Ranger Districts. For datasets and summaries, please contact Carly Lewis (US Forest Service) and Scott Tomson (US Forest Service).

Commented [rk33]: IRR. We do this at project level. PC for boreal toads based upon MT SWAP

Commented [rk34]: ACK

Commented [rk35]: ACK

Commented [rk36]: ACK We have over a decade of citizen science monitoring of boreal toads. See chapter 5 of revised plan for amphibian monitoring.

Commented [rk37]: AP, FEIS ACK See chapter 5 of revised plan for meso-carnivore monitoring.

Commented [rk38]: IRR. FNF not identified. See FEIS section 3.7.5 climate change and lynx citations

Commented [rk39]: AP, FEIS ACK See chapter 5 of revised plan for meso-carnivore monitoring.

Commented [rk40]: ACK, used Z 1995

Commented [rk41]: AP, FEIS ACK See chapter 5 of revised plan for meso-carnivore monitoring.

11. Wolverine

- Cross, Molly, and Servheen, Chris. 2009. *Climate change impacts on wolverines and grizzly bears in the Northern U.S. Rockies: Strategies for conservation.* Workshop summary report.

Commented [rk42]: ACK. Used S & C 2010. See FEIS section 6.5 and 3.7.5-- grizzly bear and wolverine and climate change, FEIS appendix 7

- Carnivore surveys (on Canada lynx, fisher, wolverine, and pine marten) conducted by Forest Service biologists from the Wildlife Monitoring Committee of the Southwestern Crown of the Continent Collaborative Forest Landscape Restoration Project between 2011 and 2014 across the Swan, Seeley Lake, and Lincoln Ranger Districts. For datasets and summaries, please contact Carly Lewis (US Forest Service) and Scott Tomson (US Forest Service).

Commented [rk43]: AP, FEIS ACK See chapter 5 of revised plan for meso-carnivore monitoring.

- Schwartz, Michael K., Copeland, Jeffrey P., Anderson, Neil J., Squires, John R., Inman, Robert M., McKelvey, Kevin S., Pilgrim, Kristy L., Waits, Lisette P., and Cushman, Samuel A. 2009. *Wolverine gene flow across a narrow climatic niche*. Ecology 90: 3222-3232.

Commented [rk44]: CON see FEIS section 3.7.5 wolverine

- Weaver, John L. 2013. *Safe havens, safe passages for vulnerable fish and wildlife: Critical landscapes in the southern Canadian Rockies, British Columbia and Montana*. Wildlife Conservation Canada Conservation Report No. 6. Toronto, Ontario, Canada. This report concludes that wolverines are highly vulnerable to climate change as warming temperatures and reduced snowpack will decrease suitable habitat for the species.

Commented [rk45]: AP, see FEIS section 3.7.5 wolverine

12. Grizzly bear

- Weaver, John L. 2013. *Safe havens, safe passages for vulnerable fish and wildlife: Critical landscapes in the southern Canadian Rockies, British Columbia and Montana*. Wildlife Conservation Canada Conservation Report No. 6. Toronto, Ontario, Canada. This report concludes that grizzly bears are highly vulnerable to disturbance of all kinds and easily displaced by roads, including those with little traffic. Thus, protection of roadless areas is key to helping this species adapt to environmental changes.

Commented [rk46]: AP, PC see FEIS section 3.7.5 grizzly bear

- Servheen, Chris, and Cross, Molly. 2010. *Climate change impacts on grizzly bears and wolverines in the Northern U.S. and Transboundary Rockies: Strategies for conservation.* Workshop summary report.

Commented [rk47]: AP, PC see FEIS section 3.7.5 grizzly bear

13. Westslope cutthroat trout and bull trout

- Peterson, Douglas P., Wenger, Seth J., Rieman, Bruce E., and Isaak, Daniel J. 2013. *Linking climate change and fish conservation efforts using spatially explicit decision support tools*. Fisheries 38: 112-127. This paper demonstrated that larger habitat patches are most likely to support bull trout in the future but that habitat occupancy will ultimately be determined by water temperature, with suitable habitat retreating upstream as temperatures increase. Additionally, this paper stresses that barrier removal and reestablishing connectivity are essential to maintain Westslope cutthroat trout on the landscape.

Commented [KR-48]: PC, See FEIS section 3.2

- Peterson, Douglas P., Rieman, Bruce E., Horan, Dona L., and Young, Michael K. 2013. *Patch size but not short-term isolation influences occurrence of Westslope cutthroat trout above human-made barriers*. Ecology of Freshwater Fisheries 1600-0633. 2013 This paper examines the effects of stream fragmentation and patch size on westslope cutthroat trout and provides the first empirical estimate for how patch size and patch- level characteristics influence persistence of westslope cutthroat trout in isolated stream networks.
- Weaver, John L. 2013. *Safe havens, safe passages for vulnerable fish and wildlife: Critical landscapes in the southern Canadian Rockies, British Columbia and Montana*. Wildlife Conservation Canada Conservation Report No. 6. Toronto, Ontario, Canada. This report assesses vulnerability to climate change and the conservation value of areas in the Southern Canadian Rockies region for a suite of six wildlife species. It recommends the

designation of conservation lands to serve as "safe havens" for these species to help ensure the continued diversity of fish and wildlife in the region. For bull trout and westslope cutthroat trout, this report concludes that both species are highly vulnerable because of their dependence on cold water for spawning and rearing, the negative impacts of non-native lake and brook trout (for bull trout) and non-native rainbow trout (for westslope cutthroat trout), fragmentation of habitat, sedimentation, and warming temperatures beyond their thermal tolerance downstream.

Commented [KR-49]: Used pub Weaver submitted specific to FNF

14. Elk

- Middleton, Arthur D.; Kauffman, Matthew J.; McWhirter, Douglas E.; et al. 2013. *Animal migration amid shifting patterns of phenology and predation: lessons from a Yellowstone elk herd*. Ecology 94: 1245-1256. This paper demonstrates how climate-driven shifts in spring green-up affect elk reproductive success. It is important for land managers to consider how changing environmental conditions may impact wildlife populations differently across seasonal ranges when planning management activities.

Commented [rk50]: IRR, CON

- Brodie, Jedediah; Post, Eric; Watson, Fred; et al. 2012. *Climate change intensification of herbivore impacts on tree recruitment*. Proceedings of the Royal Society: B, Biological Sciences 279: 1366-1370. Reduced snowpack allows elk and other herbivores to more easily access seedlings and saplings, reducing recruitment and establishment of trees following disturbance events.

Commented [rk51]: IRR. Not a problem on FNF

15. Mule deer

- Sawyer, Hall; Kauffman, Matthew J.; Middleton, Arthur D.; et al. 2013. *A framework for understanding semi-permeable barrier effects on migratory ungulates*. Journal of Applied Ecology 50: 68-78. This paper demonstrates that semi-permeable barriers such as roads and development can affect mule deer migration even when habitat connectivity is maintained. Development within migration corridors can reduce foraging opportunities and change migratory behaviors.

Commented [rk52]: IRR. Mule deer on FNF don't have mig. Corr. Like they do in open envir.

16. Mountain goat

- Weaver, John L. 2013. *Safe havens, safe passages for vulnerable fish and wildlife: Critical landscapes in the southern Canadian Rockies, British Columbia and Montana*. Wildlife Conservation Canada Conservation Report No. 6. Toronto, Ontario, Canada. This report concludes that mountain goats are highly vulnerable due to their constrained habitat niche, low reproductive rates, and sensitivity to motorized disturbance.

Commented [rk53]: AP, PC see FEIS section 3.7.4 mountain goat

17. Bighorn sheep

- Weaver, John L. 2013. *Safe havens, safe passages for vulnerable fish and wildlife: Critical landscapes in the southern Canadian Rockies, British Columbia and Montana*. Wildlife Conservation Canada Conservation Report No. 6. Toronto, Ontario, Canada. This report concludes that bighorn sheep are moderately vulnerable despite their susceptibility to disease and narrow habitat niche because they are not very sensitive to motorized disturbance.

Commented [rk54]: AP, see appendix 8 rsponse to comment bighorn sheep

In the following section we suggest several wildlife species for consideration in a monitoring program aimed at better understanding overall ecological processes or more difficult-to-detect species (such as Canada lynx):

18. Snowshoe hare:

- Mills, L. Scott; Zimova, Marketa; Oyler, Jared; et al. 2013. *Camouflage mismatch in seasonal coat color due to decreased snow duration*. Proceedings of the National Academy of Sciences of the United States of America 110: 7360-7365. Seasonal

Commented [rk55]: CON. Used Mills et al. 2005 and 2013

mismatch in species that exhibit changes in coat color is increasing. Without snow to blend in to, white hares are much more visible to predators.

19. Pollinators

- Forrest, Jessica R. K.; Thomson, James D. 2011. *An examination of synchrony between insect emergence and flowering in Rocky Mountain meadows*. Ecological Monographs 81: 469-491. There is potential for a seasonal mismatch between pollinators and flowering plants as temperatures warm and seasonal precipitation changes. However, this study found that springtime emergence of trap-nesting insects and the growth of flowering plants were both seemingly regulated by temperature more than photo- period. Thus, this paper found no evidence of de-coupling between plant and pollinator.
- Potts, Simon G.; Biesmeijer, Jacobus C.; Kremen, Claire; et al. 2010. *Global pollinator declines: trends, impacts and drivers*. Trends in Ecology and Evolution 25: 345-353. Declines in pollinator species across the globe are leading to subsequent declines in plants that depend upon them. There are many possible causes of pollinator decline, many of which interact. These include but are not limited to habitat loss and fragmentation, climate change, pathogens, and competition with other species.
- Dr. Laura Burkle at Montana State University has begun a National Science Foundation study on plant-pollinator networks in the Flathead National Forest. Please consider contacting her for local expertise on pollinators and pollination services. http://www.montana.edu/burkle

20. Aquatic invertebrates

Commented [KR-56]: See FEIS section 3.7 on pollinators

- Wallace, JB; Eggert, SL; Meyer, JL; et al. 1999. *Effects of resource limitation on a detrital-based ecosystem*. Ecological Monographs 69: 409-442. Inputs of leaf litter and woody debris from terrestrial ecosystems fuel productivity in headwater streams. Decreases in terrestrial subsidies can dramatically reduce productivity in streams, leading to lower abundance and biomass of aquatic invertebrates.
- Thomson, James R.; Bond, Nick R.; Cunningham, Shaun C.; et al. 2012. *The influences of climatic variation and vegetation on stream biota: lessons from the Big Dry in southeastern Australia*. Global Change Biology 18: 1582-1596. Reductions in catchment tree cover due to drought have negative effects on aquatic invertebrates. Land management practices that improve or restore riparian vegetation can help mitigate the effects of climate change on aquatic ecosystems.

Commented [KR-57]: IRR

- Eisen, H. G. 2013. *Changes in litter inputs and decomposition in headwater streams during a mountain pine beetle infestation of Whitebark Pine*. Master's Thesis. Changes in forest condition alter subsidies into headwater streams which in turn may impact aquatic invertebrates that feed upon these detrital inputs. Mountain pine beetle infestations may reduce in-stream productivity by reducing the quality of detrital inputs.

D. Infrastructure, such as recreational facilities and transportation and utility corridors

Section 1. Relevant Existing Information on the Ecological Impacts of Transportation Infrastructure

This section discusses relevant existing information on transportation infrastructure, and offers recommendations on the specific types of information related to infrastructure that should be included in the assessment report. In developing the assessment report, the Forest Service should gather information specified in the rule (219.6(b)) and draft handbook with an eye to identifying a need for change from previous forest management and developing plan components to meet new rule's

substantive requirements. In the context of infrastructure, the rule's requirements at 36 CFR 219.10(a) and (b)[5] directly apply. In addition, because transportation infrastructure is a major determinant of aquatic and terrestrial health, the rule's requirements related to aquatic and terrestrial health also apply and are found at 36 CFR 219.8(a).[6] The draft handbook elaborates on this requirement, requiring consideration of "infrastructure's contribution to social, economic and ecological sustainability," infrastructure "external to the plan area," and "information about the sustainability of the infrastructure including fiscal capability to maintain existing infrastructure."[7]

In the assessment phase, the Forest Service is directed to "Identify and consider relevant existing information contained in governmental or non-governmental assessments, plans, monitoring reports, studies, and other sources of relevant information."[8] To assist in fully assessing the extent of infrastructure in the forest, there are broad categories of relevant information that are easily accessible by the agency and should be reviewed. This includes, but is not limited, to: road accomplishment reports, road assessment reports, travel analysis reports, public (other government) transportation plans, the current backlog of maintenance projects on the forest, best management practice evaluations, recent NEPA or project documents related to forest roads such as travel management plans, National Visitor Use Monitoring reports, climate change models for the region, non-governmental reports relevant to the forest road system, Watershed Condition Classification assessment, total maximum daily loads related to sediment and temperature, monitoring reports, information related to Geomorphic Road Assessment and Inventory Package (GRAIP), and a host of available scientific information which analyzes the effects of roads on aquatic and terrestrial ecosystems and wildlife, some of which are referenced below.

In particular, the Forest Service published two documents that should help guide the agency's assessment of the state of the current road system and its need for change. These documents address the direct and indirect physical effects of roads, habitat fragmentation, biological invasion and other habitat changes that roads introduce and try to find the appropriate balance between the benefits of access to the national forest, the costs of road-associated effects to ecosystems and the agency's ability to maintain its road system. These documents are:

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[5] (a) *Integrated resource management for multiple use*. When developing plan components for integrated resource management … the responsible official shall consider: (1) …, trails, …(3) Appropriate placement and sustainable management of infrastructure, such as recreational facilities and transportation and utility corridors.
(b) (1) The plan must include plan components, including standards or guidelines, to provide for: … (i) Sustainable recreation; including recreation settings, opportunities, and access; and scenic character.

[6] (a) *Ecological sustainability.* (1) *Ecosystem Integrity.* The plan must include plan components, including standards or guidelines, to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity, taking into account…(iv) System drivers, including dominant ecological processes, disturbance regimes, and stressors, such as … climate change… (vi) Opportunities for landscape scale restoration.
(2) *Air, soil, and water.* The plan must include plan components, including standards or guidelines, to maintain or restore:
(i) Air quality.
(ii) Soils and soil productivity, including guidance to reduce soil erosion and sedimentation. (iii) Water quality.
(iv) Water resources in the plan area, including lakes, streams, and wetlands; ground water; public water supplies; sole source aquifers; source water protection areas; and other sources of drinking water (including guidance to prevent or mitigate detrimental changes in quantity, quality, and availability).
(3) *Riparian areas.*
[7] See Forest Service draft handbook at 1909.12, 13.6
[8] 36 CFR 219.6(a)(1)

- Gucinski, Michael, Furniss, J., Ziemer, Robert, and Martha H. Brookes. 2000. *Forest Roads: A Synthesis of Scientific Information*. Gen. Tech. Rep. PNWGTR-509. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 103 pp. Available at http://www.fs.fed.us/pnw/pubs/gtr509.pdf.
- USDA Forest Service. 2001. Roads Analysis: Informing Decisions about Managing the National Forest Transportation System. Available at http://www.fs.fed.us/eng/road_mgt/DOCSroad-analysis.shtml

They should be carefully reviewed and applied when making decisions about the future of the forest's road system.

The body of this section is divided into two sub-sections. The first is an overview based on current scientific literature of the ecological issues related to transportation infrastructure, including information on the anticipated impact of climate change on transportation infrastructure and sustainable transportation systems. The second provides information related to transportation infrastructure on the Flathead National Forest, and recommends important information to include in the assessment report.

A. Overview of Relevant Existing Information on Transportation Infrastructure in Forests

For ease of reference, Section 1 is divided into the following subsections:

I. Relevant Existing Information on the Environmental Impacts of Transportation Infrastructure

It is well understood that roads impact aquatic and terrestrial environments at multiple scales, and, in general, the more roads the greater the impact. In fact, in the past 20 years or so, scientists having realized the magnitude and breadth of ecological issues related to roads, have created a new scientific field called road ecology and have created a handful of road ecology research centers including the Western Transportation Institute at Montana State University and the Road Ecology Center at the University of California at Davis.[9] Below, we provide a summary of the current thinking around the impacts of roads and road networks to terrestrial and aquatic ecosystems, drawing heavily on Gucinski et al (2000).

Geomorphic and Hydrologic Effects

Undisturbed forested landscapes generally have high infiltration and low sediment yield, even though slopes are often steep. This is because the undisturbed forest floor absorbs rainfall and allows it to infiltrate into the subsurface. When roads exist, erosion rates increase significantly. This is because roads intercept and concentrate water, as well as provide a ready source of sediment for transport. Roads

[9] See http://www.westerntransportationinstitute.org/research/roadecology and http://roadecology.ucdavis.edu/

Commented [rk58]: AP, PC, CON see FEIS road discussions in 3.9 (Recreation and Access, 3.11 (Infrastructure), 3.2, 3.7.4, 3.7.5, 3.7.6 road effects on ecosystems

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contribute more sediment to streams than any other land management activity (Gucinski et al 2000). Surface erosion rates from roads are typically at least an order of magnitude greater than rates from harvested areas, and three orders of magnitude greater than erosion rates from undisturbed forest soils (Endicott 2008).

Erosion of sediment from roads occurs chronically and catastrophically. Every time it rains, sediment from the road surface and from cut and fill slopes is picked up by rain water that flows into and on roads. The sediment is entrained in surface flows that are often concentrated into road ditches and culverts and directed into streams. Roads also precipitate catastrophic mass failures of road cuts, beds, and fills during large storm events leading to massive slugs of sediment moving downstream and into waterways (Endicott 2008; Gucinski et al 2000).

The erosion of road-related sediment and it subsequent movement into stream systems affects the geomorphology of the drainage system in a number of ways. It directly alters channel morphology by embedding larger sediments and stream structures and filling pools. It can also have the opposite effect of increasing peak discharges and scouring channels, which can lead to disconnection of the channel and floodplain, and lowered base flows (Furniss et al 1991; Joslin and Youmans 1999). In all cases, the width/depth ratio of the stream changes which then can trigger changes in water temperature, sinuosity and other geomorphic factors important for aquatic species survival (Joslin and Youmans 1999; Trombulak and Frissell 2000). Roads also can modify flowpaths in the larger drainage network. Roads intercept subsurface flow as well as concentrate surface flow, which results in new flowpaths that otherwise would not exist, and the extension of the drainage network into previously unchannelized portions of the hillslope (Gucinski et al 2000; Joslin and Youmans 1999). The magnitude of road-related geomorphic effects varies by climate, geology, road age, construction and maintenance practices, and storm history. Severe aggradation of sediment at stream structures or confluences can force streams to actually go subsurface or make them too shallow for fish passage (Endicott 2008; Furniss et al. 1991).

Effect on Aquatic Habitat and Fish

On a landscape scale, these effects can add up to: changes in the frequency, timing, and magnitude of disturbance to aquatic habitat and changes to aquatic habitat structures (e.g., pools, riffles, spawning gravels, and in-channel debris), and conditions (food sources, refugia, and water temperature) (Gucinski et al 2000). Increased sedimentation in stream beds has been linked to decreased fry emergence, decreased juvenile densities, loss of winter carrying capacity, and increased predation of fishes, and reductions in micro-invertebrate populations that are a food source to many fish species (Gucinski et al 2000; Endicott, 2008, Rhodes et al, 1994; Joslin and Youmans 1999). Well-known native aquatic species affected by turbidity and sedimentation are salmon (coho, chinook and chum), steelhead, and a variety of trout species including bull trout, as well as other native fishes and amphibians (salamanders, tailed frogs) (Endicott 2008). In a Montana specific review of recreational impacts to wildlife, Joslin and Youmans (1999) describe the impact of excessive sedimentation and increased peak flows on fish habitat:

"Aquatic ecosystems are impacted by sediments from roads as well as the large water flushes just described….Sediment originating from roads reach streams and rivers, degrading habitat and impairing fish reproduction (Harr and Nichols 1993). Fine sediments impact spawning habitat by settling into and covering spawning gravels, and interfering with salmonid redd (nest) construction. Excessive sediments can impede intergravel water flow that provides oxygen and removes waste products, both of which are necessary for successful egg development. Roads thus increase barriers to migrating adult and juvenile salmonids and the macroinvertebrates they depend on (Furniss et al. 1991). When culverts fail during storm and runoff events, tremendous amounts of sediment can be delivered directly to the channel and from there down into lower

streams, potentially affecting sensitive fish habitat (Johnson 1995). Johnson (1995) notes that "Even on roads that appear to be so thick with alder that a sediment production concern seems ludicrous, we often find that the road tracks are still actively functioning as erosion sources." Johnson (1995) found that flows would almost double (1.96 times) where the road density was only 1.61 mi/mi^2…. When only 6% of the watershed was compacted, Harr (1986) notes significant peak flow increases, and emphasizes that building and locating roads so as to not intercept and re-direct water is very important." (Chapter 9.6)

Roads can also act as barriers to migration (Gucinski et al 2000). Where roads cross streams, road engineers usually place culverts or bridges. Both can and often interfere with sediment transport and channel processes such that the road/stream crossing becomes a barrier for fish and aquatic species movement up and down stream. For instance, a culvert may scour on the downstream side of the crossing, actually forming a waterfall up which fish cannot move. Bridges that infringe upon the channel or floodplain can trap sediment causing the stream to shallow and warm such that fish will not migrate past the bridge. This is problematic for many aquatic species but especially for anadromous species that must migrate upstream to spawn.

Effect on Terrestrial Habitat and Wildlife

Roads impact wildlife through a number of mechanisms including: direct mortality, change in movement and habitat use patterns, interference with predatory and prey relationships, alteration of the road-effected zone, and changes in land use (Trombulak and Frissell 2000). Some of these impacts result from the road itself, and some result from the uses on and around the roads. Habitat alteration is a significant consequence of roads. At the landscape scale, roads fragment habitat blocks into smaller patches that may not be able to support successfully interior forest species. Smaller habitat patches also results in diminished genetic variability, increased inbreeding, and at times local extinctions (Gucinski et al 2000; Trombulak and Frissell 2000). Roads also change the composition and structure of ecosystems along buffer zones, called edge-affected zones. The width of edge-affected zones varies by what metric is being discussed; however, researchers have documented edge effects a kilometer or more away from a road. In heavily roaded landscapes, edge-affected acres can be a significant fraction of total acres. For example, in a landscape area where the road density is 3 mi/square mile (not an uncommon road density in national forests) and where the edge-affected zone is estimated to be 500 feet from the center of the road to each side, the edge-affected zone is 56% of the total acreage.

Direct mortality and disturbance from road use impacts many different types of species. Animals that are adversely affected by people or disturbance may avoid roaded zones. Also, animals that move large distances, like bears and wolves, are more prone to collisions with vehicles (Fayrig and Ritwinski 2009), as are slow-moving migratory animals (e.g., amphibians) and reptiles who use roads to regulate temperature (Gucinski et al 2000). Although some animals might actually gravitate to road-affected zones because they are opportunistic and smart enough to avoid being hit by vehicles (e.g., ravens), many other animals will avoid these zones because they dislike or are impeded by disturbance -- e.g., road noise disturbs songbird communication (Fahrig and Rytwinski 2009).

Roads also affect ecosystems and habitats because they are also a major vector of non-native plant and animal species. This can have significant ecological and economic impacts when the invading species are aggressive and can overwhelm or significantly alter native species and systems. In addition, roads can increase harassment, poaching and collisions with vehicles, all of which lead to stress or mortality. Fahrig and Rytwinski (2009) did a complete review of the empirical literature on effects of roads and traffic on animal abundance and distribution looking at 79 studies that addressed 131 species and 30 species groups. They found that the number of documented negative effects of roads on animal abundance

outnumbered the number of positive effects by a factor of 5. Amphibians, reptiles, most birds tended to show negative effects. Small mammals generally showed either positive effects or no effect, mid-sized mammals showed either negative effects or no effect, and large mammals showed predominantly negative effects.

Roads also play a role in affecting wildfire occurrence. Research shows that human-ignited wildfires, which account for more than 90% of fires on national lands, is almost five times more likely in areas with roads (USDA Forest Service 1996a; USDA Forest Service 1998). Hence, roads affect where and how forests burn and, by extension, the vegetative condition of the forest. See Attachment 1 for more information documenting the relationship between roads and wildfire occurrence.

Commented [KR-62]: CON, see FEIS road discussions in 3.9 (Recreation and Access, 3.11 (Infrastructure), 3.2, 3.6, 3.7.4, 3.7.5, 3.7.6 road effects on ecosystems

Road density[10] thresholds and Wildlife

It is well documented that beyond specific road density thresholds, certain species will be negatively affected, and some will be extirpated. Most studies that look into the relationship between road density and wildlife focus on the impacts to large endangered carnivores or hunted game species, although high densities affect other species – for instance, reptiles and amphibians. Gray wolves (Canis lupus) in the Great Lakes region and elk (Cervus elaphus) in Montana and Idaho have undergone the most long-term and in depth analysis. Forman and Hersperger (1996) found that in order to maintain a naturally functioning landscape with sustained populations of large mammals, road density must be below 0.6 km/km² (1.0 mi/mi²). Several studies have since substantiated their claim.

Elk and Other Game Species

Elk are one of the most well studied animals in the U.S., likely because of their popularity as a game animal and their sensitivity to disturbance. The condition of other game species has also been linked to road density, including moose (Alces alces, Crete et al. 1981, Timmermann and Gallath 1982) and white-tailed deer (Odocoileus virginianus, Sage et al. 1983), but the amount of data is limited. Lyon (1983) was the first to report the impact of road density on elk populations, stating, "Habitat effectiveness can be expected to decline by at least 25 percent with a road density of 1.0 mi/mi² and by at least 50 percent with 2.0 mi/mi². As road densities increased to 5 to 6 mi/mi², elk use declined to less than 25 percent of potential." It should be noted that the pattern for elk is due to road avoidance, which is associated with some level of busy vehicular disturbance (Lyon 1983), and that conditions have been shown to improve when roads are closed to public use (Irwin and Peek 1979, Leptich and Zager 1991, Gratson et al. 2000, Rowland et al. 2005). A comprehensive review that provides dozens of citations of the impacts of roads on elk was published by Rowland et al. (2005).

Wolves and Mountain Lion

Several studies have also measured road density thresholds for wolves. Thiel (1985) reported that wolves could not survive in areas with road densities higher that 0.6 km/km². The following year, Jensen et al. (1986) documented a maximum road density of 0.6 km/km² on the Ontario-Michigan border. Mech et al. (1988) found similar findings in northern Minnesota. They observed that wolves were absent if road densities exceeded 0.58 km/km². Mech (1989) later reported that wolves persisted in areas with road

[10] We intend the term "road density" to refer to the density all roads within national forests, including system roads, closed roads, non-system roads administered by other jurisdictions (private, county, state), temporary roads and motorized trails. Please see Attachment 2 for the relevant existing scientific information supporting this approach.

densities greater than 0.58 km/km² if they were adjacent to extensive roadless areas. A congruent threshold was identified for mountain lion (Van Dyke et al. 1986).

Fuller et al. (1992) was the first study to incorporate human density into thresholds. They found a maximum threshold of 0.7 km/roads/km² with 4 humans/km² or a maximum of 0.5 km/roads/km² with 8 humans/km² in northern Minnesota. Thus, the higher the density of humans, the lower the threshold for persistence of wolves would be. More recently in the northern Great Lakes region, Mladenoff et al. (1995) found few portions of any pack territory were located in areas of road density greater than 0.45 km/km². Core areas (defined as 40 percent use) did not exceed road densities of 0.23 km/km² and no portion of any pack area was in an area of road density greater than 1.0 km/km². Wydeven et al. (2001) most recently observed that changing attitudes towards wolves has allowed them to persist in areas with road densities as high as 0.63 km/km² in Wisconsin.

Bears, lynx, and wolverine

Other wildlife species have also been found to have road density thresholds. Black bear (Ursus americanus) populations were shown to be inversely related to road density in the Adirondacks, New York (Brocke et al. 1988). Specifically, Brocke found that the pattern for black bear is due to human access and, in particular, the tiny "first-order" roads that permit hunters to easily reach remote areas. There was a strong negative relationship between road density and population fitness of grizzly bear (Ursus arctos horribilis) in the U.S. Rocky Mountains (Mace et al. 1996, Mattson et al. 1996). Similar relationships have also been found in brown bear (Ursus arctos) (Elgmork 1978 cited in Brocke et al. 1990) and hypothesized for wolverine (Gulo gulo) and lynx (Felis lynx, ICBEMP 1996b, 1996c, and Terra-Berns et al. 1997 cited in Wisdom et al. 2000).

Commented [KR-63]: CON. See FEIS section 3.7.4

Road Density and Aquatic Habitat Condition

A number of studies show that higher road densities generally lead to greater impacts to aquatic systems and habitats. Where both stream and road densities are high the incidence of connections between roads and streams can also be expected to be high, resulting in more common and pronounced effects of roads on streams than in areas where road-stream connections are less common and dense (Gucinski et al. 2000). Gucinski et al (2000) write:

"Road stream-crossings have been shown to have effects on stream invertebrates. Hawkins and others (in press) found that the aquatic invertebrate species assemblages (observed versus expected based on reference sites) were related to the number of stream crossings above a site. Total taxa richness of aquatic insect larvae (mayflies, Ephmeroptera; stoneflies, Plecoptera; and caddisflies, Trichoptera) were negatively related to the number of stream crossings. Another study (Newbold and others 1980) found significant differences between macroinvertebrate assemblages above and below road-stream crossings.

Several studies at broad scales document aquatic habitat or fish density changes associated with road density or indices of road density. Eaglin and Hubert (1993) showed a positive correlation with numbers of culverts and stream crossings and amount of fine sediment in stream channels, and a negative correlation with fish density and numbers of culverts on the Medicine Bow National Forest. Macroinvertebrate diversity was demonstrated to be negatively correlated with an index of road density (McGurk and Fong 1995). Increasing road densities are associated with decreased likelihood of spawning and rearing of non-anadromous salmonids in the upper Columbia River basin, and populations are negatively correlated with road density (Lee and others 1997)." (Page 34)

A number of studies have shown that watersheds with few or no roads are in better condition and have stronger fish populations than those that are more roaded. Quigley and Arbelbide (1997) showed that sub-basins having the highest forest-integrity index were largely unroaded, and increasing road densities -- combined with the activities associated with roads -- are correlated with declines in anadromous salmonid species. Gucinski et al (2000) make a compelling case that unroaded areas have stronger fish populations:

"Analysis of fish distribution and status data for seven species of anadromous and resident salmonids in the Columbia basin showed that the frequency of strong populations generally declined with increasing road densities. Additional analyses of road effects focused on four nonanadromous species because effects of roads and other land uses on anadromous species may be masked by migrational and ocean-related factors (for example, dam passage, predation, harvest). Three species showed significant road effects, either when occupied spawning and rearing areas were distinguished from unoccupied areas or when strong status was differentiated from depressed. The analysis suggested a decreasing likelihood of occupancy, or a decreasing likelihood of strong status if occupied, with increasing road density. No other variables except ground-slope showed the consistent patterns across all species shown by the road-density measures.

The investigation of the influence of roads on population status clearly showed an increasing absence and a decreasing proportion of strong populations with increasing road density for several subgroups of fish. Additional evidence suggested that the lowest mean road-density values (number of road miles per unit area) are always associated with strong population status….

Consistent, significant effects for other species may be further testament to the presence and pervasiveness of the effects. Strong relations between roads and the distribution and status of these species were detected despite the potential confounding effects of other variables (such as harvest, non-native introductions, and other habitat factors). These results show that increasing road densities and their attendant effects are associated with declines in the status of four non- anadromous salmonid species. These species are less likely to use highly roaded areas for spawning and rearing and, if found, are less likely to have strong populations. This consistent pattern is based on empirical analysis of 3,327 combinations of known species' status and subwatershed conditions, limited primarily to forested lands administered by the Forest Service and the Bureau of Land Management…

Most aquatic conservation strategies acknowledge the need to identify the best habitats and most robust populations to use as focal points from which populations can expand, adjacent habitat can be usefully rehabilitated, or the last refugia of a species can be conserved in unroaded areas where biophysical processes are still operating without effects from many human disturbances. These refugia also provide necessary experimental controls for evaluating the effects of land management activities in other areas. The ecological importance of unroaded areas has been highlighted in the Columbia basin assessment, as well as in other reports (FEMAT
1993, Henjum and others 1994).

The overlap of unroaded areas--both within and outside of designated wilderness areas—with stronghold watersheds for fish and with important conservation watershed efforts in the Columbia basin was also examined. Designated wilderness and unroaded areas are important anchors for strongholds throughout the basin. Unroaded areas occupy 41 percent of the area

with known and predicted strongholds in the east-side EIS area. One third of this area is outside of wilderness. Of the known and predicted strongholds in the upper Columbia basin area, 68 percent are unroaded, of which 37 percent are outside of wilderness." (pages 37-38)

Anderson et al (2012) also showed that watershed conditions tend to be best in areas protected from road construction and development. Using the US Forest Service's Watershed Condition Framework assessment data, Anderson showed that National Forest lands that are protected under the Wilderness Act, which provides the strongest safeguards, tend to have the healthiest watersheds. Watersheds in Inventoried Roadless Areas – which are protected from road building and logging by the Roadless Area Conservation Rule – tend to be less healthy than watersheds in designated Wilderness, but they are considerably healthier than watersheds in the managed landscape.

Some studies have tried to quantify aquatic related road density thresholds. According to Endicott (2008), "Cederholm et al. (1981) found that the percent fine sediment in spawning gravel increased above natural levels when more than 2.5% of the drainage basin was covered by roads. King and Tennyson (1984) found that the hydrologic behavior of small forested watersheds was altered when as little as 3.9% of the watershed was occupied by roads. Other scientists looking at large scale physical variables that relate to fish abundance have also noted that increased road density yields lower fish abundance (Lee et al., 1997) or occurrence (Dunham and Rieman 1999)." Frissell and Carenefix (2009) provide a concise review of studies that correlate cold water fish abundance and road density, and from the cited evidence concluded that "1) no truly "safe" threshold road density exists, but rather negative impacts begin to accrue and be expressed with incursion of the very first road segment; and 2) highly significant impacts (e.g., threat of extirpation of sensitive species) are already apparent at road densities on the order of 0.6 km per square km (1 mile per square mile) or less." Lastly, U.S. Fish and Wildlife Service's Final Rule listing bull trout as threatened (USFWS 1999) addressed road density, stating:

"A recent assessment of the interior Columbia Basin ecosystem revealed that increasing road densities were associated with declines in four non-anadromous salmonid species (bull trout, Yellowstone cutthroat trout, westslope cutthroat trout, and redband trout) within the Columbia River Basin, likely through a variety of factors associated with roads (Quigley & Arbelbide 1997). Bull trout were less likely to use highly roaded basins for spawning and rearing, and if present, were likely to be at lower population levels (Quigley and Arbelbide 1997). Quigley et al. (1996) demonstrated that when average road densities were between 0.4 to 1.1 km/km\2\ (0.7 and 1.7 mi/mi\2\) on USFS lands, the proportion of subwatersheds supporting "strong" populations of key salmonids dropped substantially. Higher road densities were associated with further declines." Page 58922.

Commented [KR-64]: CON see FEIS section 3.2

II. Relevant Existing Information on Climate Change and Transportation Infrastructure

Reducing fragmentation to enhance adaptation

Forests fragmented by roads will likely demonstrate less resistance and resilience to stressors, like those associated with climate change (Noss 2001). First, the more a forest is fragmented (and therefore the higher the edge/interior ratio) the more the forest loses its inertia characteristic, and becoming less resilient and resistant to climate change (Noss 2001). Second, the more a forest is fragmented characterized by isolated patches, the more likely the fragmentation will interfere with the ability of species to track shifting climatic conditions over time and space. Noss (2001) predicts that weedy species with effective dispersal mechanisms might benefit from fragmentation at the expense of native species. He suggests that getting rid of unneeded roads, especially in potentially important corridors, and creating wildlife crossings over busy roads could mitigate some of the road-related fragmentation effects.

Commented [KR-65]: CONS see FEIS sections 3.7.4, 3.7.5 and 3.7.6

Modifying Infrastructure to Increase Resilience

It is expected that climate change will be responsible for more extreme weather events, leading to increasing flood severity, more frequent landslides, changing hydrographs (peak, annual mean flows, etc.), and changes in erosion and sedimentation rates and delivery processes. Roads and trails in national forests, if designed by an engineering standard at all, were designed for storms and water flows typical of past decades, and hence may not be designed for the storms in future decades. Hence, climate driven changes in climate may cause transportation infrastructure to malfunction or fail (ASHTO 2012; USDA Forest Service 2010). The likelihood is higher for facilities in high-risk settings—such as rain-on-snow zones, coastal areas, and landscapes with unstable geology (USDA Forest Service 2010). To prevent or reduce road failures, culvert blow-outs, etc., forest managers will need to take a series of actions. These include replacing undersized culverts with larger ones, prioritizing maintenance and upgrades (e.g., installing drivable dips and more outflow structures), and obliterating roads that are no longer needed and pose erosion hazards (USDA Forest Service 2010; USDA Forest Service 2012; USDA Forest Service 2011).

Olympic National Forest has developed a number of documents oriented at oriented at protecting watershed health and species in the face of climate change, including a 2003 travel management strategy and a report entitled Adapting to Climate Change in Olympic National Park and National Forest. In the travel management strategy, Olympic National Forest recommended that 1/3rd of its road system be decommissioned and obliterated (USDA Forest Service 2011). In addition, the plan called for addressing fish migration barriers in a prioritized and strategic way – most of these are associated with roads. The report calls for road decommissioning, relocation of roads away from streams, enlarging culverts as well as replacing culverts with fish-friendly crossings (USDA Forest Service, 2011). Below, we provide a copy of Chart 5.5 from the report that lists fish adaptation strategies, many of which are related to the road system.

Commented [KR-66]: CONS. See FEIS appendix 7

Figure 6.

Table 5.2—Current and expected sensitivities of fish to climate change on the Olympic Peninsula, associated adaptation strategies and actions for fisheries and fish habitat management at Olympic National Forest (ONF) and Olympic National Park (ONP)[a]

Current and expected sensitivities	Adaptation strategies and actions
Novel ecosystem response to shifting climate and hydrology	• Shift to a new paradigm in fish habitat management that recognizes that pre-existing channel conditions may no longer be an accurate representation of the potential state. • Incorporate climate change into the ONF Strategic Plan.
Changes in fish distribution, population size, and viability	• Implement strategic monitoring; build from existing monitoring programs.
Changes in timing of fish life history events	• Use tools such as NetMap to identify areas most likely to exhibit a climate change signal. • Monitor restoration projects to determine strengths and weaknesses of existing projects, and improve design of future restoration projects. • Look for early indications of change to determine how quickly some of the climate-related changes are occurring, and use that information to adjust management priorities.
Changes in habitat quantity and quality	• Implement habitat restoration projects that focus on re-creating watershed processes and functions and that create diverse, resilient habitat.
Increase in culvert failures, fill-slope failures, stream adjacent road failures, and encroachment from stream-adjacent road segments	• Decommission unneeded roads. • Remove sidecast, improve drainage, and increase culvert sizing on remaining roads. • Relocate stream-adjacent roads.
Greater difficulty disconnecting roads from stream channels	• Design more resilient stream crossing structures.
Major changes in quantity and timing of streamflow in transitional watersheds	• Make road and culvert designs more conservative in transitional watersheds to accommodate expected changes.
Increased erosion and sediment delivery to channels.	• Consider adding large wood to small headwater channels to restore natural sediment routing (ONF lands). • Consider thinning in steep landslide-prone areas to accelerate development of large wood inputs to streams (ONF lands).
Increased thermal stress on cold-water-adapted fish species Decreased fish numbers owing to reductions in suitable habitat and productivity	• Limit mortality associated with recreational fishing through time and area closures as necessary.
Increased risk of disease introduction from hatchery fish Increased disease virulence with warmer stream temperatures	• Encourage implementation of Hatchery Scientific Review Group recommendations for hatchery reforms. • Follow 2006 National Park Service policies regarding the planting of hatchery fish within parks. • Control spread of exotic species.

Decline in native fish populations owing to increased competition from exotic species Increased spread of aquatic invasive species	• Monitor to detect increases in invasive populations; initiate control measures aggressively. • Educate the public about measures to prevent the spread of invasive species. • Focus habitat protection and restoration efforts on existing wild fish strongholds and streams that are less influenced by hatcheries.
Loss of cold water refugia for cold-water-adapted fish species	• Identify and protect cold water refugia.
Decrease in area of headwater streams. Decrease in habitat quantity and connectivity for species that use headwater streams.	• Continue to correct culvert fish passage barriers. • Consider re-prioritizing culvert fish barrier correction projects. • Restore habitat in degraded headwater streams that are expected to retain adequate summer streamflow (ONF).
Increased sensitivity for species that spawn in late summer (e.g., summer chum, summer coho, spring chinook)	• Limit mortality associated with recreational fishing through time and area closures as necessary.

[a] Sensitivities are based on projected climate change effects on the Olympic Peninsula, including increased winter precipitation and runoff, more precipitation falling as rain rather than snow, increased storm intensity, greater winter and spring streamflows in some types of watersheds, increased flood frequency and magnitude in some types of watersheds, elevation shifts in transition (rain-on-snow) zones, reduced summer streamflows, and increased stream temperatures.

In December 2012, the Forest Service published a report entitled "Assessing the Vulnerability of Watersheds to Climate Change." This document reinforces the concept expressed by Olympic National Forest that forest managers need to be proactive in reducing erosion potential from roads:

"Road improvements were identified as a key action to improve condition and resilience of watersheds on all the pilot Forests. In addition to treatments that reduce erosion, road improvements can reduce the delivery of runoff from road segments to channels, prevent diversion of flow during large events, and restore aquatic habitat connectivity by providing for passage of aquatic organisms. As stated previously, watershed sensitivity is determined by both inherent and management-related factors. Managers have no control over the inherent factors, so to improve resilience, efforts must be directed at anthropogenic influences such as instream flows, roads, rangeland, and vegetation management….

[Watershed Vulnerability Analysis] results can also help guide implementation of travel management planning by informing priority setting for decommissioning roads and road reconstruction/maintenance. As with the Ouachita NF example, disconnecting roads from the stream network is a key objective of such work. Similarly, WVA analysis could also help prioritize aquatic organism passage projects at road-stream crossings to allow migration by aquatic residents to suitable habitat as streamflow and temperatures change." (USDA Forest Service 2012, Pages 22-23)

Switalski (2009) echoes the Forest Service conclusions regarding strategies to reduce aquatic stressors and increase aquatic resilience, and also suggests that road decommissioning, which reduces fragmentation and increases landscape connectivity, is also an important climate change adaptation strategy:

"Decommissioning and upgrading roads and thus reducing the amount of fine sediment deposited on salmonid redds can increase the likelihood of egg survival and spawning success (McCaffery et al. 2007). In addition, this would reconnect stream channels and remove barriers such as culverts. Decommissioning roads in riparian areas may provide further benefits to salmon and other

aquatic organisms by permitting reestablishment of streamside vegetation, which provides shade and maintains a cooler, more moderated microclimate over the stream (Battin et al. 2007).

For wildlife, road decommissioning can reduce the many stressors associated with roads. Road decommissioning restores habitat by providing security and food for wildlife. Preliminary results suggest that black bear (Ursus americanus) use decommissioned roads extensively in central Idaho (A. Switalski in prep.). In addition to providing early successional foods, such as huckleberries, decommissioned roads when seeded with native species can reduce the spread of invasive species (Grant et al. in review).

One of the most well documented impacts of climate change on wildlife is a shift in the ranges of species (Parmesan 2006). As animals migrate, landscape connectivity will be increasingly important (Holman et al. 2005). Decommissioning roads in key wildlife corridors will improve connectivity and be an important mitigation measure to increase resiliency of wildlife to climate change."

Commented [KR-67]: CON PC see FEIS appendix 7 and infrastructure objectives in revised plan

Roads and carbon

The topic of the relationship of road restoration and carbon has only recently been explored. Here, we provide the results of two studies that both show that road restoration has positive implications for carbon sequestration. In 2008, Kerkvliet et al published a Wilderness Society briefing memo on the impact to carbon sequestration from road decommissioning. Noting that the discussion of carbon sequestration usually revolves around timber harvest or conservation designations, the authors suggested that an overlooked opportunity to sequester carbon on National Forests rests with its massive road system. Using Forest Service estimates of the fraction of road miles that are unneeded, the authors calculated that restoring 126,000 miles of roads to a natural state would be equivalent to revegetating an area larger than Rhode Island. In addition, they calculate that the net economic benefit of road treatments are always positive and range from US$0.925-1.444 billion.

Redwood National Park staff, renowned for their expertise in road restoration, explored a similar question. Madej et al (2012) assessed the carbon budget implications of 30 years of road decommissioning in Redwood National Park in north coastal California. They found that treatment of 425 km of logging roads from 1979 to 2009 resulted in a net carbon savings of 49,000 Mg C to date. The authors also provide a procedure to assess carbon budgets on restoration sites that should be transferable to other systems.

Commented [KR-68]: PC see infrastructure objectives in revised plan. See FEIS carbon sequestration section.

Protecting Unroaded Areas as a Climate Change Adaptation Strategy

The Forest Service, National Park Service, and US Fish and Wildlife Service recognize that protecting and connecting roadless or lightly roaded areas is an important action agencies can take to enhance climate change adaptation. For example, the Forest Service National Roadmap for Responding to Climate Change (2011) establishes that increasing connectivity and reducing fragmentation are short and long term actions the Forest Service should take to facilitate adaptation to climate change.[11] The National Park Service also identifies connectivity as a key factor for climate change adaptation along with establishing "blocks of natural landscape large enough to be resilient to large-scale disturbances and long-term changes" and other factors. The agency states that: "The success of adaptation strategies will be enhanced by taking a broad approach that identifies connections and barriers across the landscape. Networks of protected areas within a larger mixed landscape can provide the highest level of resilience to

[11] Forest Service, 2011. *National Roadmap for Responding to Climate Change*. US Department of Agriculture. FS-957b. Page 26.

climate change."[12] Similarly, the National Fish, Wildlife and Plants Climate Adaptation Partnership's Adaptation Strategy (2012) calls for creating an ecologically-connected network of conservation areas.[13]

Commented [KR-69]: PC see revised plan appendix G, see FEIS, FEIS appendices 4 and 7

III. Relevant Existing Information on the Value of Roadless Areas and Network of Roadless Areas

Undeveloped natural lands provide numerous ecological benefits. They contribute to biodiversity, enhance ecosystem representation, and facilitate connectivity (Loucks et al 2003; Crist and Wilmer 2002; Wilcove 1990; The Wilderness Society, 2004; Strittholt and Dellasala 2001; DeVelice and Martin 2001), and provide high quality or undisturbed water, soil and air (Anderson et al, 2012; Dellasalla et al 2011). They also can serve as ecological baselines to help us better understand our impacts to other landscapes, and contribute to landscape resilience to climate change.

Forest Service roadless lands, in particular, are heralded for the conservation values they provide. These are described at length in the preamble of the Roadless Area Conservation Rule (RACR)[14] as well as in the Final Environmental Impact Statement (FEIS) for the RACR[15], and include: high quality or undisturbed soil, water, and air; sources of public drinking water; diversity of plant and animal communities; habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land; primitive, semi-primitive non- motorized, and semi-primitive motorized classes of dispersed recreation; reference landscapes; natural appearing landscapes with high scenic quality; traditional cultural properties and sacred sites; and other locally identified unique characteristics (e.g., include uncommon geological formations, unique wetland complexes, exceptional hunting and fishing opportunities).

In addition to the description of the value of roadless lands to the conservation of biodiversity in the FEIS, numerous articles in the scientific literature recognize the contribution of roadless and undeveloped lands for biodiversity, connectivity, and conservation reserve networks. For example, Loucks et al (2003) examined the potential contributions of roadless areas to the conservation of biodiversity, and found

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[12] National Park Service. *Climate Change Response Program Brief.* http://www.nature.nps.gov/climatechange/adaptationplanning.cfm. Also see: National Park Service, 2010. *Climate Change Response Strategy*. http://www.nature.nps.gov/climatechange/docs/NPS_CCRS.pdf. Objective 6.3 is to "Collaborate to develop cross-jurisdictional conservation plans to protect and restore connectivity and other landscape-scale components of resilience."

[13] See http://www.wildlifeadaptationstrategy.gov/pdf/NFWPCAS-Chapter-3.pdf. Pages 55- 59. The first goal and related strategies are:

Goal 1: Conserve habitat to support healthy fish, wildlife, and plant populations and ecosystem functions in a changing climate.

Strategy 1.1: identify areas for an ecologically-connected network of terrestrial, freshwater, coastal, and marine conservation areas that are likely to be resilient to climate change and to support a broad range of - fish, wildlife, and plants under changed conditions.

Strategy 1.2: Secure appropriate conservation status on areas identified in Strategy 1.1 to complete an ecologically-connected network of public and private conservation areas that will be resilient to climate change and support a broad range of species under changed conditions.

Strategy 1.4: Conserve, restore, and as appropriate and practicable, establish new ecological connections among conservation areas to facilitate fish, wildlife, and plant migration, range shifts, and other transitions caused by climate change.

[14] Federal Register .Vol. 66, No. 9. January 12, 2001. Pages 3245-3247.

[15] Final Environmental Impact Statement, Vol. 1, 3–3 to 3–7

that more than 25% of IRAs are located in globally or regionally outstanding ecoregions and that 77% of IRAs have the potential to conserve threatened, endangered, or imperiled species. Arcese and Sinclair (1997) highlighted the contribution that IRAs could make toward building a representative network of conservation reserves in the United States, finding that protecting these areas as reserves would expand ecoregional representation, increase the area of reserves at lower elevations, and increase the number of areas large enough to provide refugia for species needing large tracts relatively undisturbed by people. Crist and Wilmer (2002) looked at the ecological value of roadless lands in the Northern Rockies and found that protection of national forest roadless areas, when added to existing federal conservation lands in the study area, would 1) increase the representation of virtually all land cover types on conservation lands at both the regional and ecosystem scales, some by more than 100%; 2) help protect rare, species-rich, and often-declining vegetation communities; and 3) connect conservation units to create bigger and more cohesive habitat "patches."

Roadless lands also are responsible for higher quality water and watersheds. Anderson et al (2012) assessed the relationship of watershed condition and land management status and found a strong spatial association between watershed health and protective designations. Dellasalla et al (2011) found that undeveloped and roadless watersheds are important for supplying downstream users with high-quality drinking water, and developing these watersheds comes at significant costs associated with declining water quality and availability. The authors recommend a light-touch ecological footprint to sustain the many values that derive from roadless areas including healthy watersheds.

Gucinski et al (2000) also provides an extensive discussion on the value of roadless areas and roadless area networks. He discusses the non-use values that roadless areas have, including "having significant amounts of interior habitat for many forest species …., maintaining connectivity of habitat for species having large home-ranges, valuing the existence of forest "reserves" that permit the continued functioning of representative habitat types in a state of least human disturbance, and becoming aware that forest-stream interactions appear to confer somewhat stronger fish viability in areas of low to none road densities." (Page 81). He also discusses the passive use value of roadless areas – that is, the value that people give an area for being roadless, either because they simply enjoy knowing that it is undeveloped or because they value that it will remain undeveloped for future generations. They note that the passive-use value of roadless areas often exceeds the active-use value served (or potentially served) by road access, and that building roads in roadless areas may reduce passive-use value significantly while decommissioning roads may increase such value. On the other hand he notes that building roads into roadless areas may serve values that require such access, and decommissioning roads may obstruct values and uses that require access. Decision makers need to consider all of these tradeoffs.

Lastly, the benefits of roadless areas and roadless area networks to climate change adaptation are discussed above in section II.

Commented [KR-70]: CON see FEIS

IV. Relevant Existing Information on Sustainable Transportation Management in National Forests

A sustainable transportation system can be defined as one where all the routes are constructed, located, and maintained with best management practices, and social and environmental impacts are minimized. The reality is that even the best roads and road networks are problematic simply because they exist and usher in land uses that without the roads would not occur (Trombulak and Frissell 2000; Frissell and Carnefix 2009; USDA Forest Service 1996b), and when they are not maintained to the designed level they result in environmental problems (Endicott 2008; Gucinski et al 2000). Moreover, with climate change effects such as increased storm intensities, roads designed to meet older climate criteria may no longer hold up under new climate scenarios (USDA Forest Service 2010; USDA Forest Service 2011; USDA Forest Service 2012; AASHTO 2012).

The challenge for forest managers is figuring out what is a sustainable road system and how to achieve it – a challenge that is exacerbated by climate change. Gucinski et al (2000) strongly recommend that forest managers utilize the Roads Analysis Process developed by the Forest Service in 2001 to illuminate issues and provide strategies that will contribute to finding an acceptable balance between road benefits and costs:

"Roads Analysis is intended to be an integrated, ecological, social, and economic approach to transportation planning. It uses a multiscale approach to ensure that the identified issues are examined in context. Roads Analysis is to be based on science. Analysts are expected to locate, correctly interpret, and use relevant existing scientific literature in the analysis, disclose any assumptions made during the analysis, and reveal the limitations of the information on which the analysis is based. The analysis methods and the report are to be subjected to critical technical review." (Page 10)

In an effort to help determine minimum road systems, The Wilderness Society in 2012 finalized a GIS decision support tool called RoadRight that identifies high risk road segments to a variety of forest resources including water, wildlife, and roadlessness (The Wilderness Society, 2012; The Wilderness Society, 2013). The GIS system is designed to provide information that will help forest planners identify and minimize road related environmental risks. See the summary of and user guide for RoadRight that provides more information including where to access the open source software.[16]

Shilling et al (2012) developed a recreational route optimization model with the goal of identifying a sustainable motorized transportation system for the Tahoe National Forest. The model identified routes with high recreational benefits, lower conflict, lower maintenance and management requirements, and lower potential for environmental impact operating under the presumption that such routes would be more sustainable and preferable in the long term. The authors combined the impact and benefit analyses into a recreation system analysis "that was effectively a cost-benefit accounting, consistent with requirements of both the federal Travel Management Rule (TMR) and the National Environmental Policy Act."

Adams and McCool (2009) also considered this question of sustainable motorized recreation. They offered ten recommendations to federal agencies, including:

(2) As the agencies move to revise allocations, they need to clearly define how they intend to locate routes so as to minimize impacts to natural resources and other recreationists in accordance with Executive Order 11,644. Given judicial deference, if the agencies fail to do so, the minimization standard of Executive Order 11,644 will remain meaningless.[17]

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[16] The Wilderness Society, 2012. Rightsizing the National Forest Road System: A Decision Support Tool. Available at http://www.landscapecollaborative.org/download/attachments/12747016/Road+decommissioning+model+-overview+2012-02-29.pdf?version=1&modificationDate=1331595972330.

The Wilderness Society, 2013.
RoadRight: A Spatial Decision Support System to Prioritize Decommissioning and Repairing Roads in National Forests User Guide. RoadRight version: 2.2, User Guide version: February, 2013. Available at http://www.landscapecollaborative.org/download/attachments/18415665/RoadRight%20User%20Guide%20v22.pdf?api=v2

[17] Recent court decisions have made it clear that the minimization requirements in the Executive Orders are not discretionary and that the Executive Orders are enforceable. See

(3) As they proceed with designation, the FS and BLM need to acknowledge that current allocations are the product of agency failure to act, not design. Ideally, ORV routes would be allocated as if the map were currently empty of ORV routes. Reliance on the current baseline will encourage inefficient allocations that likely disproportionately impact natural resources and non- motorized recreationists. While acknowledging existing use, the agencies need to do their best to imagine the best possible arrangement of ORV routes, rather than simply tinkering around the edges of the current allocations. (Page 105)

Commented [KR-71]: CON. See Travel Analysis Process for FNF in planning record.

The Forest Service Road System is not Sustainable

At 375,000 miles strong, the Forest Service road system is one of the largest in the world – it is eight times the size of the National Highway System. It is also indisputably unsustainable – that is, roads are not designed, located, or maintained according to best management practices, and environmental impacts are not minimized. It is largely recognized that forest roads, especially unpaved ones, are a primary source of sediment pollution to surface waters (Endicott 2008; Gucinski et al 2000), and that the system has about 1/3rd more miles than it needs (USDA Forest Service 2001a). In addition, the majority of the roads were constructed decades ago when road design and management techniques did not meet current standards (Gucinski et al 2000; Endicott 2008), making them more vulnerable to erosion and decay than if they had been designed today. Also, road densities in national forests generally exceed accepted thresholds for wildlife.

Only a small portion of the road system is regularly used. All but 18% of the road system is inaccessible to passenger vehicles. Fifty-five percent of the roads are accessible only by high clearance vehicles and 27% are closed. The 18% that is accessible to cars is used for about 80% of the trips made within National Forests.[18] In other words, only about 1/5th of the roads in the national forest system are used most of the time, and the fraction that is used often is the best designed because they are higher level access roads. The remaining roads sit generally unneeded and under-maintained – arguably a growing ecological and fiscal liability.

Twenty percent of the road system is maintained adequately. Historically, the Forest Service had funds to build and maintain roads, but as timber harvests declined, so too did road maintenance funding. The Forest Service currently has a $3.7 billion road maintenance backlog, and can generally with appropriated funds maintain around 20% of the road system to standard. The bulk of that funding goes towards passenger vehicle roads, which are most important for access.

The graph below clearly illustrates the consequence of under-funding road maintenance. Initially, roads deteriorate slowly, but once roads reach a certain stage of disrepair, they begin to deteriorate at an exponentially faster rate (Moore 2007). As roads deteriorate, their impacts on water quality generally

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- *Idaho Conservation League v. Guzman* , 766 F. Supp. 2d 1056 (D. Idaho 2011) (Salmon-Challis National Forest TMP) .
- *The Wilderness Society v. U.S. Forest Service*, CV 08-363 (D. Idaho 2012) (Sawtooth-Minidoka district National Forest TMP).
- *Central Sierra Environmental Resource Center v. US Forest Service*, CV 10-2172 (E.D. CA 2012) (Stanislaus National Forest TMP).

[18] USDA Forest Service. Road Management Website Q&As. Available online at http://www.fs.fed.us/eng/road_mgt/qanda.shtml.

increase (Endicott 2008).

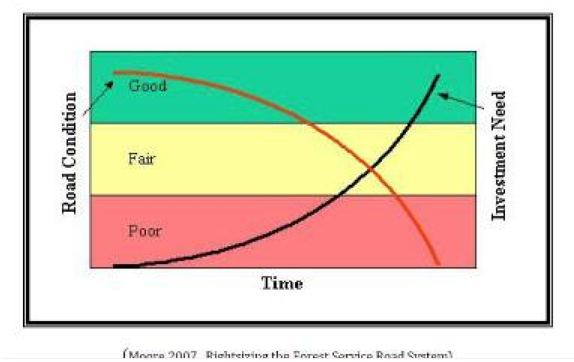

Figure 7. Rightsizing the Forest Service Road System (Moore 2007)

Forest roads have been cited as a serious stressors to forest and watershed health on our national forests (Endicott 2008). Recognizing this, in 2001, the Forest Service promulgated the Roads Rule (36 cfr 215 subpart A) that directed every national forest to identify a minimum necessary road system and identify unneeded roads for decommissioning. According to the accompanying environmental assessment, the purpose of the roads rule was to begin working toward a sustainable transportation system (USDA Forest Service 2001a). The Forest Service then developed the aforementioned Roads Analysis Process (RAP), and published Gucinski et al (2000) to provide the scientific foundation to complement the RAP. Because by 2010, very few forests had completed a RAP that looked at all roads, the Forest Service leadership issued direction that all forests had to complete a Travel Analysis Report (TAR, a revised RAP) by the end of FY 2015 and begin to implement the minimum roads system through project level decisions and plans.[19]

Given the importance of the TAR and its role as a blueprint for working towards a sustainable roads system, the forest plan assessment should utilize the information and communicate the recommendations in the TAR in order to inform a need for change and the development of plan components.

Commented [KR-72]: CON. See Travel Analysis Process for FNF in planning record.

V. Relevant Existing Information on Restoration Frameworks and Strategies

In order to meet the substantive requirements in the rule related to ecological integrity and sustainable access, the forest plan revision must provide direction for moving towards a sustainable transportation infrastructure system. The forest assessment therefore should provide the best available science on restoration frameworks. As discussed above, the first step in restoring road-impacted landscapes is to identify the minimum necessary road system. With the subset of roads identified as unnecessary, the next step is to assign priorities for removing roads and assigning methods (e.g., full obliteration, pulling culverts only). In this subsection, we describe a few approaches to priority setting based on different objectives.

[19] See Forest Service directive memo dated March 29, 2012 entitled “Travel Management, Implementation of 36 CFR, Part 202, Subpart A (36 CFR 212.5(b))”

If the objective is to enhance resilience to climate change, numerous authors have echoed the approach suggested by the National Fish, Wildlife and Plants Climate Adaptation Partnership in Strategy 1.4 of its Climate Change Adaptation Plan (2012), where the Partnership recommends "Conserv[ing], restor[ing], and as appropriate and practicable, establish[ing] new ecological connections among conservation areas to facilitate fish, wildlife, and plant migration, range shifts, and other transitions caused by climate change." Rieman et al (1997), researchers at the Forest Service Intermountain Research Station, having considered the relative impacts of wildfire and roads to bull trout and redband trout on the Boise National Forest, concluded:

"The population characteristics that provide for resilience in the face of such events, however, likely depend on large, well connected and spatially complex habitats that can be lost through chronic or press effects of other management. A critical element to resilience and persistence of many populations for these and similar species will be the restoration or maintenance of highly complex, well connected habitats, across a mosaic of stream and watersheds." (Page 55)

If the objective is the restoration of watersheds and water quality, Gucinski et al (2000) highlight the benefits of removing roads from watersheds that contain high–quality habitat and have only limited road networks in to secure large amounts of habitat with small expenditures for stormproofing and decommissioning. Also, it can be cost-effective and effective to focus storm-proofing treatments on older roads in sensitive terrain and roads that have been functionally abandoned but not adequately configured for long-term drainage (Gucinski et al 2000).[20]

If the objective is ecological integrity above and below ground, Lloyd et al (2013) found that it is important to recountour fully the roads and not simply abandon them or just rip the road bed. This is an issue because managers must weigh initial economic costs with both short- and long-term ecosystem benefits, and full recountouring can be much more expensive than simply ripping or abandoning a road. The authors suggest that "active recontouring can dramatically accelerate the recovery of soil properties by hundreds to thousands of years, as compared with never-roaded reference areas. In contrast, belowground properties and processes along abandoned roads remain in a degraded state even 30 or more years after road closure and revegetation."

Lastly, if the objective is holistic ecological restoration, then discussions by Rieman et al (1997) and USDA Forest Service (1996) related to the trade-offs and associated risks between vegetative management (including restoration) and aquatic habitat condition must be considered. In the former, Rieman et al (1997) argue that native fish may be somewhat adapted to pulses of sediment and related changes to aquatic habitats that result from fire events, and that the chronic infusion of sediment into waterways from roads and timber harvest may in fact be a determinative factor in diminishing their ability to adapt because of the persistent and spatially broad effect of reducing well connected and spatially complex habitats.

"By expanding our efforts in timber harvest to minimize the risks of large fire, we risk expanding what are well established negative effects on streams and native salmonids….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 (citing Baker 1994; Stanley 1995). The perpetuation or expansion of existing road networks, and other activities might well erode the

[20] Recent research by the Rocky Mountain Research Station is showing that select decommissioning and stromproofing at the locations with the worst potential for erosion can be effective. See http://www.wildlandscpr.org/files/GRAIP%20Report%20Wildlands%20CPR_0.pdf.

ability of populations to respond to the effects of large scale storms and other disturbances that we clearly cannot change.

There is growing interest for intensive forest management to reestablish more natural landscape patterns and disturbance regimes, but the risks and benefits of that management vary across the landscape. In our haste, forest health treatment projects have been justified from all perspecties including the risk of extinction for sensitive species such as bull trout and redband trout. Our experience with the effects of the recent fires is incomplete. The picture that emerges both from our experience and the avaialble literature, however, suggests that the consequences of large fires are not as catastrophic as some have anticipated." (Pages 55-56)

In its review of scientific findings in the Interior Columbia Basin, the USDA Forest Service (1996) states: "It is not fully known whether building roads to reduce fire risk causes greater risk to aquatic systems than realizing the potential risk of fire." (Page 105)

Commented [KR-73]: PC for watersheds, aquatic species, RMZs, infrastructure objectives, revised plan appendix E; CON see FEIS, FEIS appendix 7

B. Relevant Existing Information on Transportation Infrastructure Specific to the Flathead National Forest

In this sub- section, we provide a few resources that provide information on the Flathead National Forest's road system, and we offer suggestions for information that we feel is important for inclusion within the assessment report. We were unable to locate the Flathead National Forest's Roads Analysis Report, which, if it exists, would most likely provide a good summary of the benefits and costs of the Flathead's road system. As we understand it, the Flathead National Forest and Region 1 are currently developing the Travel Analysis Report for the forest, which is required to be completed no later than September 31, 2015, and should provide a robust cost/benefit analysis of all roads on the forest. The Flathead National Forest should ensure that the information from the Roads Analysis Report, if it exists, and the Travel Analysis Report is reflected in the assessment report.

According to the 2005 Analysis of the Management Situation (AMS) for the Flathead National Forest, developed as part of an earlier plan revision attempt, the Flathead has a total of 3,504 miles of system roads, 52% or 1,824 miles of which are in the Maintenance Level 1 category meaning that they are closed to motorized use. In addition, the forest has a total of 6,189 miles of trails, with 3,005 miles or less open to motorized use. The Flathead projects an annual maintenance budget (current and deferred work) of $6.2 million dollars, and in 2005 receives just under $1 million each year for this work.

The AMS, in identifying a need for change, states:

"There is a need to modify current management direction in order to facilitate reasonable access to National Forest lands, minimizes environmental effects, and can be maintained with current budgets. *Management direction needs to be in the form of a long-term strategy that emphasizes motorized and/or non-motorized travel opportunities in appropriate places in order to meet resource and social needs.*

There is a need for consistent direction across forest boundaries to provide understanding and consistent regulations for the public while managing resource issues in a similar manner across boundaries. *This strategy also needs to focus on road decommissioning in places where resource benefits can be optimized.*

The challenge is to find a reasonable balance between access-related use and resource protection. *This new management direction needs to be applied across larger landscape scales. The current management direction provides several goals, objectives, and standards related to*

access management, but this direction lacks spatial and temporal components. We know we need to provide reasonable access to the forests for public use and resource management. The challenge is to determine where to encourage access and where to minimize it in a larger landscape context." (Page 4-6, emphasis added)

We imagine that much of this direction still holds true. Moreover, it dovetails well with the current Forest Service direction to develop a Travel Analysis Report and comply with subpart A of the Travel Management Rule that requires every forest to identify a minimum road system and unneeded roads for decommissioning.[21] As expressed in the environmental assessment for subpart A, a purpose of the regulation was to move towards a road system that meets resource and access needs, economical management, and environmental protection and begins to reverse ecological damage caused by the extensive road system that currently exists (USDA Forest Service 2001a).

Commented [KR-74]: See FNF Travel Analysis Report in planning record

Aquatic Health and Roads

In terms of aquatic impacts, we direct your attention to two reports published by the Swan View Coalition:

- Hammer, Keith. 2004. Watersheds at Risk: Roads Threaten Bull Trout on the Bitterroot, Flathead and Lolo National Forests. Prepared for Swan View Coalition, May 2004.

This report examines baseline bull trout data produced by the Forest Service on the Flathead National Forest. *"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... Road reclamation is found necessary to restore appropriate function to watersheds damaged by roads."*

- Hammer, Keith. 2003. Off the Charts: Roads Outnumber Streams in Developed Flathead Watersheds. Prepared for Swan View Coalition. April 2003.

Commented [KR-75]: DATED

This report looks at two watershed scale indicators of watershed health: 1) road mile to stream mile ratios, and 2) road density for the Flathead National Forest. The author explains why these indicators are important for maintaining and restoring watersheds for the wildlife habitat, water quality and fish habitat they provide. Data indicate the miles of road outnumber the miles of stream in roaded sub-watersheds within the Forest boundary. Only 23% of the sub-watersheds remain roadless.

"Ninety-two percent of the roaded sub-watersheds have road densities in excess of levels where most strong bull trout populations occur and in excess of recommended standards for grizzly bear recovery. Fifty-eight percent of the roaded sub-watersheds have road densities in excess of levels which significantly displace grizzly bear from otherwise preferred habitats." (Executive Summary)

The Road/Stream Ratio (road miles/stream miles) provides a measure of the degree to which roads compete with native streams in determining the hydrologic function of the watershed. Ratio values greater than zero indicate the hydrology of the watershed has departed from its historic roadless regime. A threshold value of 1.0 is used to determine whether there are more miles of road than stream.

[21] 36 CFR 212.5(b)

Road Density (road miles/square miles) is commonly used in the scientific literature. A threshold value of 0.45 mi/mi2 is taken from the literature as the watershed road density at or below which most strong bull trout populations occur. This value is also used to approximate the 0.32 mi/mi2 recommended as a maximum road density standard to accomplish grizzly bear recovery. A threshold value of 2.0 mi/mi2 is taken from the literature as the road density above which grizzly bear are significantly displaced from otherwise preferred habitats.

On the whole, there are 1.2 times more road miles than stream miles in the roaded subwatersheds (9,092/7,607). More particularly, 55% of the 130 roaded sub-watersheds have more miles of road than stream - often considerably more, 6% have equal miles, and 38% have fewer miles of road than stream.

On the whole, 92% of the roaded sub-watersheds have road densities often well in excess of 0.45 miles/square mile, inferring those that are or once were bull trout watersheds are now less likely to contain strong bull trout populations. (Pages 2-3)

In addition to reflecting the information in the above reports, the assessment report should also include information on impaired water segments, effectiveness of best management practices, past decommissioning practices and outcomes, road density by sub-watershed, road/stream crossing occurrences by sub-watershed, road segments in riparian areas, road segments on soils and slopes with high erosion potential, and connectivity of aquatic habitats.

Commented [KR-76]: See FEIS section 3.2

Terrestrial Health and Roads

In terms of terrestrial ecosystem condition and roads specific to the Flathead, we ask that the Flathead in the assessment report summarize current thinking regarding road density and species of concern including the grizzly bear, as well as provide an overlay of road densities and specific habitat extents and maps showing where road densities exceed accepted thresholds for species of conservation concern. We note that the 2005 AMS identified roads as one of the principle causes for the dramatic change in forested habitat conditions since early European settlement (see Page 4-21). The assessment report should also assess the amount, location, size, and connectivity of roadless patches.

Commented [KR-77]: See FEIS sections 3.7.4, 3.7.5, 3.7.6, appendix 8 roads

Sustainable transportation system

The assessment report should assess the sustainability of the road system on the Flathead National Forest. Are the routes within the forest constructed, located, and maintained with best management practices? Are social and environmental impacts are minimized? Is the system fiscally sustainable over time without sacrificing resource protection or consistent and safe access? To answer these questions, the assessment report should describe available models for assessing sustainability, and if possible, utilize one or more of them to illuminate the degree to which the Flathead's system is sustainable. Also, given the importance of the TAR and its role as a blueprint for working towards a sustainable roads system, the assessment report should utilize the information and communicate the recommendations in the TAR.

Commented [KR-78]: See FNF TAP or TAR in planning record, see appendix 8

Relevant trends and conditions related to infrastructure

We recommend that the assessment report provide information on relevant trends and conditions related to transportation infrastructure. These could include:

- Distribution of maintenance levels over time. Are a higher proportion of roads in maintenance level 1 and 2 categories than in previous years? If so, why?
- Road-related aquatic impacts over time. Are more or less stream segments impaired for road-related sediment than 5, 10, or 20 years ago?
- Storm related road failures over time. Is the Flathead National Forest experiencing relatively more or less road failures in recent years? What is the cost of addressing these failures over time? Is road failure and accelerated erosion anticipated to become more prevalent in the future, because of climate change, inadequate maintenance or some other reason?
- Road use over time. Is the volume of traffic changing over time? Is the type of use (recreational, commercial) changing over time? How does the volume and type of use break down by maintenance class?
- Transportation infrastructure funding over time. How has funding (including both Forest Service and other sources) changed, and how is it projected to change? What will these anticipated funding trends mean for the condition of the transportation system?
- Predicted climate change trends in the region and implications for infrastructure. Do climate models predict more intense storms? Are culverts and other road structures designed to handle higher peak flows, if anticipated?

Commented [KR-79]: See FNF TAP or TAR in planning record

E. Existing designated areas located in the plan area including wilderness and wild and scenic rivers and potential need and opportunity for additional designated areas

There is a potential need and opportunity for additional designated areas, including recommended wilderness, on the Flathead National Forest. The 1987 Flathead NF Forest Plan proposed to add 98,080 acres to the National Wilderness Preservation System, identifying these acres (from the Bear-Marshall-Scapegoat-Swan roadless area) as Recommended Wilderness:

- Middle Fork Flathead River 6,295 Acres
- East Side South Fork Flathead River 5,187 Acres
- Swan Crest 31,783 Acres
- Swan Front 54,815 Acres

(1987 *Flathead National Forest Land & Resource Management Plan, Summary of the Analysis of the Management Situation*, VI-7)

The 2006 Proposed Land Management Plan for the Flathead NF, which was never completed and implemented due to changes in the forest planning rule, also made recommendations for wilderness on the forest, and for more acres than the 1987 plan.

MA	Management Area Designation	Acres	Percent	Acres generally suitable for timber harvest	Acres generally suitable for timber production
1.1	Designated Wilderness[1]	1,020,200	43.4	0	0
1.2	Recommended Wilderness	141,243	6.0	0	0
2.1	Wild and Scenic Rivers - Designated	41,942	1.8	23,691	0
2.1a	Wild and Scenic Rivers – Eligible or Suitable	44,263	1.9		0
2.2	Backcountry	319,542	13.6	194,541	0
3.1	Areas under Special Management (Jewel Basin Hiking Area and Coram Experimental Forest)	29,675	1.3	6,375	0
3.2	Research Natural Areas	8,523	0.4	0	0
3.3	General Forest Low Intensity Management	279,783	11.9	242,410	0
4.1	General Forest Moderate Intensity Management	220,911	9.4	41,039	161,089
5.1	General Forest High Intensity Management	189,967	8.1	15,284	167,239
5.2	Residential Forest Intermix	32,961	1.4	30,024	0
6.1	High Use Recreation Complexes or Use Areas	19,226	0.8	15,196	0
Total		2,348,237	100.0	568,560	328,328

Figure 8. Management areas, acres, and percent of the Forest generally suitable for timber harvest and timber production, as depicted in the 2006 Proposed Flathead National Forest Land Management Plan, p. 96.

The acres recommended in the 1987 Forest Plan certainly remain important in the context of new information 26 years later, and the 2006 proposed additions were a further step in the right direction. But as outlined below, the needs of wildlife and aquatic species, new information about the importance of protected lands for a variety of ecological and socio-economic values, and the significance of the Flathead NF's wilderness potential on a national scale would suggest the need for wilderness recommendations on a greater number of acres in additional roadless areas on the forest in the upcoming plan revision.

1. *The Flathead National Forest has the opportunity for additional designated areas.*

This opportunity lies in the fact that there are some 478,000 acres of inventoried roadless areas (IRAs) plus additional un-inventoried roadless areas on the Flathead NF, and most are not currently protected with a conservation designation specific to the ecological and social benefits they provide. By conferring protective designations, including recommended wilderness, in the forest planning process, we can meet outstanding ecological and socio-economic needs. In particular, we can protect important habitats and species and connect conservation areas regionally to enhance biodiversity and climate change adaptation. We can ensure the integrity of the aquatic systems that not only serve as habitats for sensitive, threatened, and endangered species, but also contribute to local and regional outdoor economies and supplies of fresh, clean water for local communities. We can also provide additional places for people to experience nature and wildness, and pursue outdoor nature-based activities.

2. *The Flathead National Forest has the need for additional designated areas, for the following reasons:*

<u>The Flathead NF has some of the wildest land remaining in the lower 48 states.</u>

In addition to considering the importance of locally informed designation recommendations in the forest planning process, we hope you will also consider the national significance of the Flathead National Forest for the role it can play in protecting some of the best remaining tracts of wildlands in the lower 48 states.

Using a spatial dataset developed to quantify and combine multiple indicators of wildness across the U.S. (Aplet et al. 2000), Aplet et al assessed the average wildness index of all national forest lands in the contiguous 48 states. Grounded in the understanding that wildness is present in varying degrees in all lands as a function of the relative freedom and naturalness of a place, the wildness index was based on aggregated values for six attributes, including solitude, remoteness, uncontrolled processes, natural composition, unaltered structure, and pollution. The value of this wildness index is that it allows for a consistent comparison of wildness values across a regional and national scale, helping to identify the largest remaining patches of wildlands as well as the potential to connect them. This study excluded lands already within the National Wilderness Preservation System so that we could assess wildland values of lands not currently within wilderness areas.

Of all national forest service administered lands over 10,000 acres, the non-wilderness portions of the Flathead NF ranked in the top 5% wildest areas nationally (Figures X and X). When compared with areas of 1 million acres or more, the non-wilderness lands on the Flathead NF ranked number 4 out of 53 areas in terms of their relative wildness index (see Aplet et al. 2000 for further description of the index). When evaluating areas for special designations (i.e., recommended additions to the National Wilderness Preservation System), please consider the national significance of the wildlands located in the Flathead National Forest.

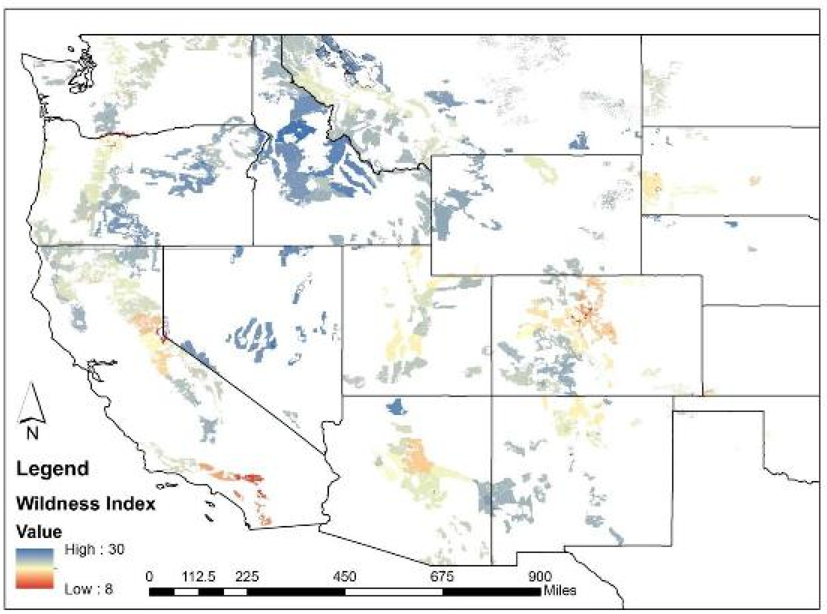

Figure 9. Relative "wildness" of National Forest Service Units in the western U.S., excluding areas within National Wilderness Preservation System (NWPS). Blue areas are relatively more wild than redder areas. The Flathead National Forest is shown in a thin black outline. In short, the wildness index was generated by combining national datasets representing indices or proxies of the following values: opportunities for solitude, remoteness, uncontrolled processes, natural composition of vegetation, unaltered structure, and pollution. See Aplet et al. 2000 for more details on this dataset. The Flathead National Forest ranks in the top 5% most wild places, highlighting its importance in sustaining national wilderness character values.

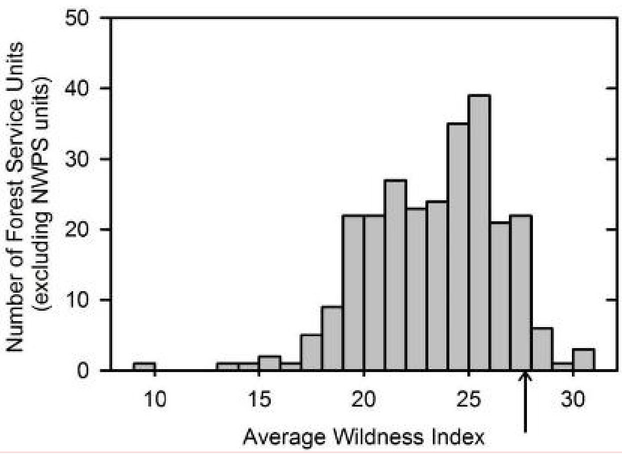

Figure 10. A histogram of the wildness index for all Forest Service land units above 10,000 acres and excluding lands in the NWPS. The ranking of the Flathead National Forest is indicated by the black arrow along the x-axis. Figure courtesy of Travis Belote, TWS.

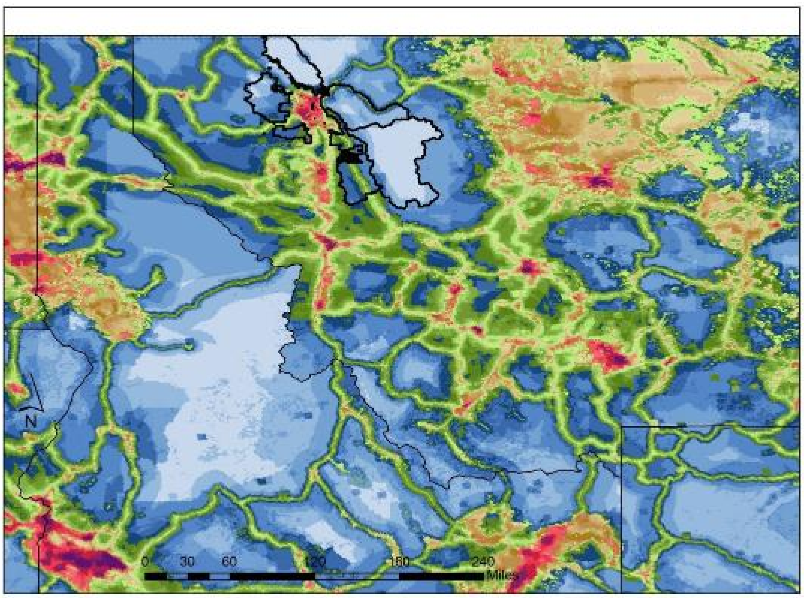

Figure 11. Relative "wildness" of the Flathead NF (outlined in black), shown at the Northern Rockies regional scale. Blue areas are relatively more wild than redder area; this figure includes areas in the NWPS. As described above, the wildness index was generated by combining national datasets representing indices or proxies of the following values: opportunities for solitude, remoteness, uncontrolled processes, natural composition of vegetation, unaltered structure, and pollution. See Aplet et al. 2000 for more details on this dataset (data are available here: http://www.arcgis.com/home/item.html?id=33fbfd2697134c00bc66b4a7b438f4b1)

Americans increasingly use and are satisfied with wilderness areas; use of wilderness is also on the rise on the Flathead NF, and the majority of recreational users engage in wilderness-compatible recreational pursuits

The USDA National Visitor Use Monitoring Survey (NVUM) in 2011 found that visitation to Wilderness areas on national forests in 2011 was up more than 15% from 2009 levels (NVUM Survey 2011 at 7). Visitors to Wilderness areas nationwide are more likely to travel from farther away: 30% of Wilderness visitors come from a distance of greater than 200 miles, compared with 21% of general National Forest visits (NVUM Survey 2011 at 7). There do not seem to be significant differences between the duration of visits to National Forests vs. Wilderness areas, suggesting that accessible wilderness areas for single-day pursuits are valued alongside more remote wilderness areas. (NVUM Survey, 11). Finally, both visitor satisfaction ratings overall and the satisfaction ratings of visitors with specific elements of their experience were very high for national forest Wilderness areas, suggesting that the USFS is doing a good job of meeting the current needs of Wilderness visitors. (NVUM Survey, 31)

Specific to the Flathead NF, while visitation and site visits on the Flathead NF have decreased since the last NVUM survey in 2005, wilderness visitors have increased by more than 50% -- from 13,000 to 20,000 between 2005 and 2010. (NVUM Survey--Flathead, 2) The most popular recreational pursuits enjoyed by visitors are compatible with wilderness values, including viewing natural features (42% of visitors), viewing wildlife (30%), relaxing (34%), walking/hiking (34%), and hunting (18%). Other popular activities included alpine skiing (30%, primarily at local resorts on the FNF under special use permits) and driving

for pleasure (20%). By contrast, off-highway vehicle use is enjoyed by only 2% of FNF visitors. (NVUM Survey—Flathead, 2)

Wilderness and inventoried roadless areas contribute significantly to water quality and aquatic habitat integrity.

One of the most important benefits of national forests is their contribution to maintaining supplies of cold, clear water for local communities and terrestrial and aquatic ecosystems. In a time of climate change, the quantity and quality of our water resources is becoming increasingly important and insecure, and in the context of national forests, it appears that Wilderness and roadless lands make a disproportionately positive contribution to maintaining and safeguarding these resources. The two studies cited here (as well as a number of others in our additional references) may be particularly helpful since they distinguish between designated Wilderness and roadless areas. In the 2003 Region 1 Wilderness Needs Assessment, the USFS stated that most assessments of native fish populations do not distinguish between these two land categories (USFS Region 1, 2003 at 5)

In 2011, Secretary of Agriculture Tom Vilsack announced the release of the US Forest Service's Watershed Condition Classification Map, which characterizes the health and condition of more than 15,000 watersheds on National Forest System lands. The Wilderness Society overlaid the watershed condition data from the new USFS Watershed Condition Framework with three general land management categories in the National Forest System: designated Wilderness, Inventoried Roadless Areas, and all other lands. (Anderson et al 2012) The purpose of this analysis was to evaluate, quantify, and display at a national scale spatial relationships and correlations between land management categories and the USFS' three watershed condition classes (functioning properly, functioning at risk, impaired function). This analysis did not attempt to establish any causal relationship.

This analysis found a strong spatial coincidence between Wilderness – and, to a lesser degree Inventoried Roadless Areas – and healthy watershed conditions:
"National forest lands that are protected under the Wilderness Act, which provides the strongest safeguards, tend to have the healthiest watersheds. Watersheds in Inventoried Roadless Areas – which are protected from road building and logging by the Roadless Area Conservation Rule – tend to be less healthy than watersheds in designated Wilderness, but they are considerably healthier than watersheds in the managed landscape." (Anderson et al, 9)

At a scale more local to the Flathead National Forest, Hitt and Frissell investigated the role of Congressionally designated wilderness in the conservation of aquatic biointegrity in western Montana. This paper contributes important information to the relatively understudied significance of Wilderness for aquatic systems (rather than terrestrial systems, which are better studied), as well as conducting an analysis specific to western Montana watersheds that should be helpful to the Flathead NF in developing its need for change on protective designations.

Hitt and Frissell found that Wilderness areas had disproportionately higher Aquatic Diversity Area (ADA) scores than subwatersheds with other uses: "over 65% of the high scoring ADAs were found in Wilderness subwatersheds. In several cases, clear patterns of high-scoring watersheds followed the boundaries of wilderness areas." (Hitt and Frissell, 141) They also found that while this was the case, wilderness designation didn't guarantee high ADA scores, particularly in smaller, disconnected wilderness areas in western Montana, e.g., Welcome Creek or the Anaconda-Pintler wilderness areas. Their results also indicated the following:

1) *Wilderness areas are important areas of aquatic biointegrity in western Montana,*
2) *The presence of wilderness does not guarantee aquatic biointegrity, and*

3) *Given their importance and rarity, unprotected areas with relative aquatic biointegrity merit permanent protection for conservation of aquatic ecosystems.*

(Hitt and Frissell 141)

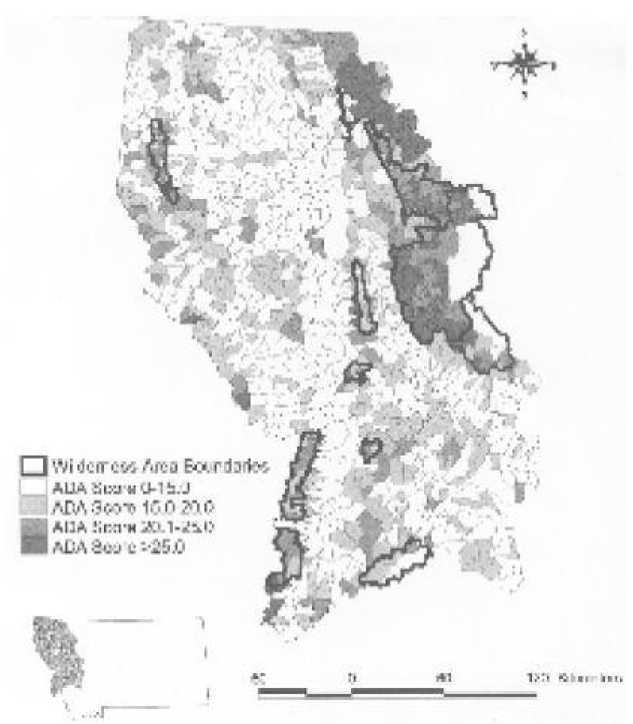

Figure 12. Aquatic Diversity Area (ADA) scores (from Frissell and others 1996) and wilderness areas in western Montana. Higher scores [darker colors] indicate high relative aquatic biointegrity for indices of road density, fish stocking history, native fish presence/absence, and sensitive and endangered species presence. Potential scores ranged from 0-40. Actual scores ranged from 1.46 to 31.13. (Hitt and Frissell 2000)

Taken together, these findings suggest a need to identify those areas – the Swan Range, the Whitefish Range – that are <u>both</u> adjacent to existing wilderness and other protected areas (i.e., the Bob Marshall Wilderness complex, Glacier NP) <u>and</u> that currently have higher ADA scores, and potentially investigate and prioritize those areas more highly for new designations.

As Hitt and Frissell state, “we must recognize that the importance of wilderness in aquatic conservation is extraordinary.”(141) We believe that the challenge of climate change will only amplify the important role of wilderness in preserving the integrity of aquatic ecosystems and sources of clean water for western Montana communities into the future.

<u>The Flathead has Inventoried Roadless Areas (IRAs) that, if protected as wilderness, could contribute substantial conservation benefits for the larger USFS Region 1 Wilderness System.</u>

When USFS Region 1 conducted its Wilderness Needs Assessment in 2003, it conducted several analyses to identify rare plant species occurrences in Wilderness areas and IRAs and to determine where additional Wilderness designations may benefit these species. The Assessment found that “the protection of additional IRAs in Region 1 could enhance the conservation of occupied habitats for 71 sensitive plant species that are not protected in the existing wilderness network…[and] the designation of additional wilderness acreage in the Region could also provide a greater level of habitat security for 91 additional plant species that are rare at the global or state level.” (USFS Region 1, 2003 at 9) The accompanying map for this analysis shows that there are significant roadless acres, particularly in the Swan Range and Hungry Horse area, where additional designations should be considered in order to help meet conservation goals for sensitive plant species.

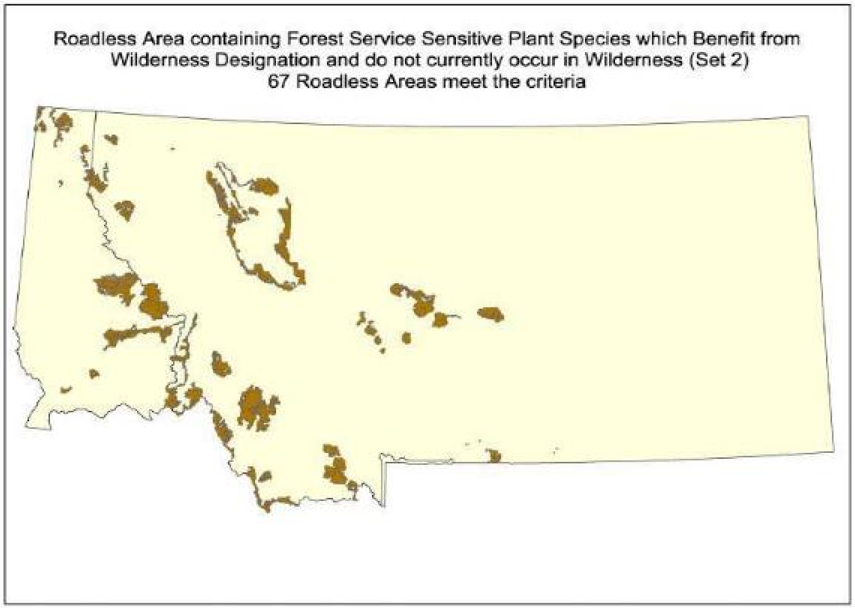

Figure 13. Results from an evaluation of the conservation benefits that could be obtained by the addition of Wilderness acreage in USFS Region 1, for sensitive plant species occurring in IRAs but not represented in Wilderness. (USFS Region 1, 2003 at 13)

Region 1’s Wilderness Needs Assessment also identified under-represented plant communities which are not currently represented in Wilderness, but that are present in IRAs, quantifying the acres of IRAs that are occupied by these communities and that could potentially fill the gap. These include riparian and wetland types (46,544 acres in Wilderness, 115,541 acres in IRAs), peatlands (no acres in Wilderness, 13% in IRAs), aspen communities (.3% of Wilderness, 7.1% in IRAs), shrublands and grasslands (195,932 acres in Wilderness, 341,811 acres in IRAs).

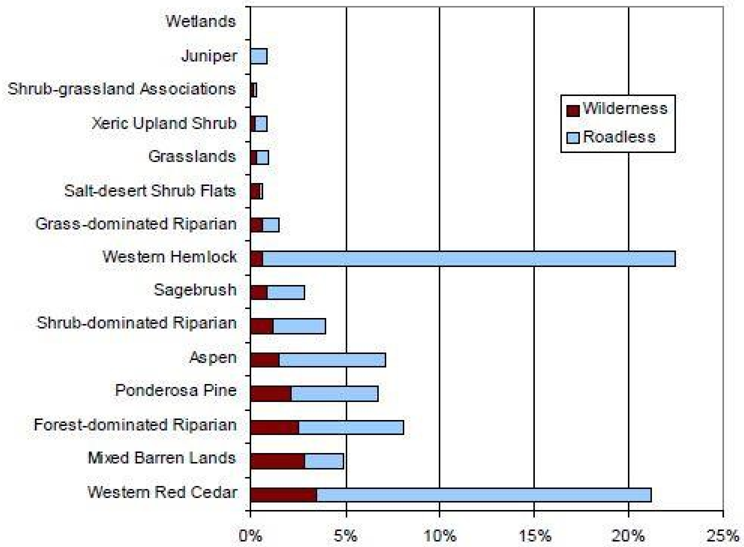

Figure 14. Bars represent the percentage of selected land cover types in designated wilderness and inventoried roadless for all lands in Montana and Idaho which are within the Northern Region boundary. For example, there are 3.3 million acres of Ponderosa Pine (all land ownerships) within the Montana and Idaho portion of the Northern Region; of these 3.3 million acres, approximately 70,000 acres are in designated wilderness, (i.e., 0.07 / 3.3 = 2.1%) and approximately 151,000 acres are in inventoried roadless (i.e., 0.15 / 3.3 = 4.5%). (USFS Region 1, 2003, at 20)

We look forward to the FNF's discussion and identification in the forest plan of the contributions it can make at the forest scale to rounding out the representation of plant communities in the Region 1 Wilderness system.

The Flathead's roadless lands have high value for wildlife, especially in a time of climate change, and many should be considered for wilderness protection.

Two recent reports by Dr. John Weaver on wildlife needs in the Crown of the Continent Ecosystem, which includes the Flathead NF, highlight the importance of existing wilderness protections, the contribution of roadless areas to healthy wildlife populations in the region, and the need for additional designations. Weaver assessed the vulnerability of a suite of species -- including bull trout, westslope cutthroat trout, grizzly bear, wolverines, mountain goat, and Rocky Mountain bighorn sheep – and then considered their current geographic occurrence and connectivity with core habitat (i.e., National Parks and Wilderness) to inform recommendations for additional protected areas in the region. Considering the need to implement more "climate-smart" strategies throughout the Northern Rockies, including "1) increase the extent and effectiveness of protected areas, 2) enhance connectivity within and around large ecosystems, and 3) reduce pressure on species and ecosystems from sources other than climate change" (Weaver 2011, 7), such recommendations will "promote resilience by keeping future options open through an emphasis on ecological variability across space and time." (Weaver 2011, 6).

Based on composite conservation values that scored "very high" or "high" for this suite of wildlife species, Weaver makes recommendations for protection of specific roadless areas on the Flathead NF,

including in the Swan River – Southern Flathead River Basin (which includes the Swan Lake, Spotted Bear, and Hungry Horse ranger districts of the FNF):

1) 72,815 acres as additions to the Bob Marshall Wilderness:

- *The Swan Range from Holland Lake north to Inspiration Point*
- *An area around Spotted Bear Mountain*

2) 7,137 acres as additions to the Mission Mountains Wilderness (USFS):

- *Small areas in Elk Creek and Piper Creek and around upper Lindbergh Lake*

3) 173,602 acres as additions to the Great Bear Wilderness:

- *Higher elevation portions of the Swan Range from Bunker Creek north to Columbia Mountain*
- *Above the east shore of Hungry Horse Reservoir, the basins from Unawah Mountain south to Dry Park Mountain,*
- *Paola Ridge area above the lower Middle Fork Flathead River, and*
- *Slippery Bill Mountain and Patrol Ridge area along the Continental Divide in the Middle Fork of the Flathead River Basin.*

(Weaver, 111-112)

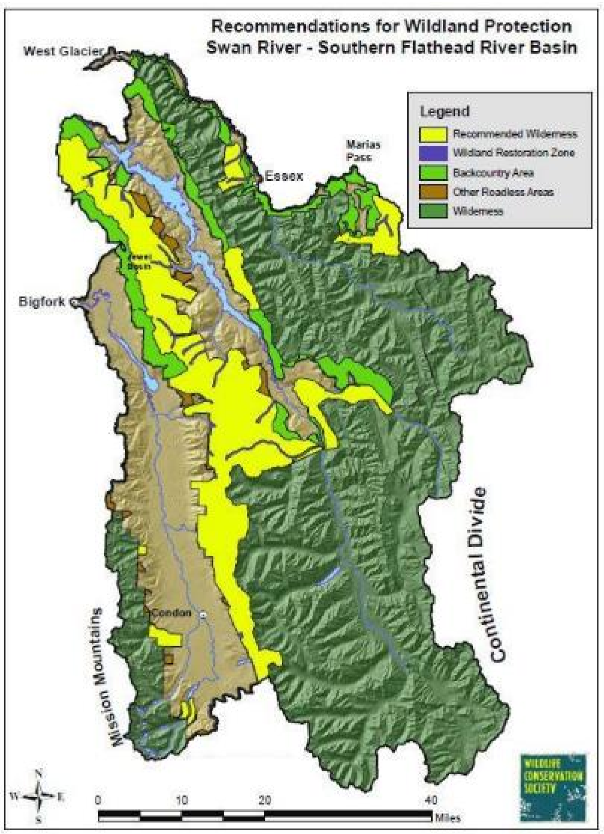

Figure 15. Recommendations for wildland protection, Swan River and Southern Flathead River Basin, Crown of the Continent Ecosystem, Montana. (Weaver 2011, 115)

Weaver makes further recommendations about designation of areas as backcountry that emphasize non-motorized recreation and fish and wildlife conservation, as well as identifying an area above Hungry Horse Reservoir for additional road closures and wildland restoration, building on the substantial road closure and decommissioning work the Flathead NF has already done in that area.

Roadless Unit	Wilderness		Backcountry		Other Roadless		WRZ	
	Ac	%	Ac	%	Ac	%	Ac	%
Swan River Valley	74,248	74.8	19,534	19.7	5,291	5.3	167	0.2
South Fork/Hungry Horse	157,845	67.7	64,558	27.7	9,894	4.2	1025	0.4
Middle Fork	21,461	48.7	22,194	50.4	-	-	377	0.9
TOTAL	**253,554**	**67.3**	**106,286**	**28.2**	**15,185**	**4.0**	**1,569**	**0.4**

Figure 16. Number of acres recommended for Wilderness, Backcountry, Other Roadless, and Wildland Restoration Zone (WRZ), Swan River – Southern Flathead River basin, Crown of the Continent Ecosystem, Montana. (Weaver 2011, 113)

For the North Fork Flathead River Basin (primarily on the Glacier View Ranger District of the FNF), Weaver recommends 127,160 acres be designated as Wilderness, including:

- *Thoma-Mt. Hefty area*
- *Tuchuck area*
- *Mount Thompson-Seton south to Lake Mountain, including the headwater basins of Williams Creek and Blue Sky Creek on the west side of the Whitefish Divide*
- *Headwaters of Hay Creek and Coal Creek, and*
- *South end of the Whitefish Range from Haines Pass south to Werner Peak.*

(Weaver, 126)

Weaver (2013) reiterates and refines wilderness recommendations for the Whitefish Range region in *Safe Havens, Safe Passages for Vulnerable Fish and Wildlife: Critical Landscapes in the Southern Canadian Rockies, British Columbia and Montana* (2013), continuing to prioritize Thoma-Mt. Hefty, Tuchuck, and Mount Thompson-Seton for wilderness protection, while shifting Hay and Coal Creeks and the south end of the Whitefish Range into a recommendation for backcountry non-motorized designation and a prioritized wildland restoration zone. (Weaver 2013, 116)

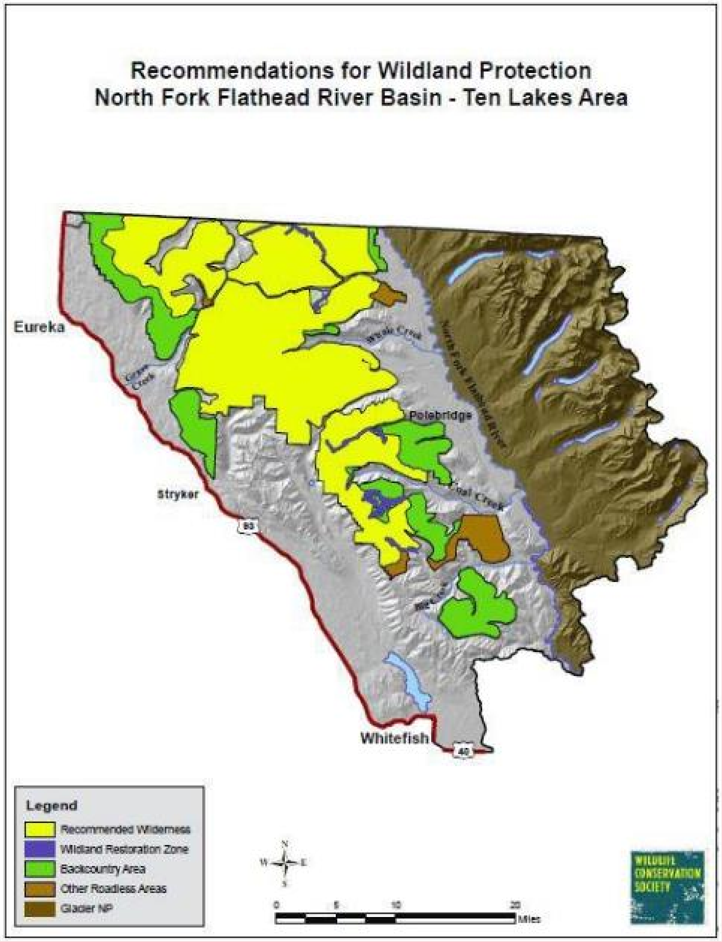

Figure 17. Recommendations for wildland protection, North Fork Flathead River Basin and Ten Lakes area, Crown of the Continent Ecosystem, Montana. (Weaver 2009, 129)

Roadless Unit	Wilderness		Backcountry		Other Roadless		WRZ	
	Ac	%	Ac	%	Ac	%	Ac	%
North Fork Flathead River	127,160	71.0	37,400	20.9	12,433	7.0	2025	1.1

Figure 18. Number of acres recommended for Wilderness, Backcountry, Other Roadless, and Wildland Restoration Zone (WRZ), North Fork Flathead River Basin, Crown of the Continent Ecosystem, Montana. (Weaver 2009, 127)

Wilderness, especially within a network of connected reserves, may be more relevant than ever as part of an overall approach to landscape-scale management in a time of climate change.

While wilderness is being re-examined by some as the impacts of climate change are becoming more apparent in landscapes across the West – indeed, the USFS Region 1 Wilderness Needs Assessment questions its value as a management tool for meeting the needs of native fish, for example (USFS Region 1, 2003 at 5) -- others argue compellingly that wilderness continues to be a viable conservation strategy to meet a number of objectives.

Undeveloped natural lands, especially those whose function and integrity is protected as wilderness, provide numerous ecological benefits: contributing to biodiversity, enhancing ecosystem representation, and facilitating connectivity (Loucks et al 2003; USDA 2001; Crist and Wilmer 2002; The Wilderness Society 2004; Strittholt and Dellasala 2001, DeVelice and Martin 2001). Crist and Wilmer specifically examined the ecological value of roadless lands in the Northern Rockies and found that protection of national forest roadless areas, when added to existing federal conservation lands in the study area,
would 1) increase the representation of virtually all land cover types on conservation lands at both the regional and ecosystem scales, some by more than 100%; 2) help protect rare, species-rich, and often-declining vegetation communities; and 3) connect conservation units to create bigger and more cohesive habitat "patches."

Tabor et al 2013 (alongside Caro et al.) cite the importance of wilderness as a benchmark -- or reference system or control -- by which to assess managed lands and the effects of management strategies in areas prioritized for active restoration and management in a portfolio approach to managing climate risk. Wilderness and protected areas can enhance the resilience of systems to the impacts of climate change. The ability to allow for uninterrupted or re-established fire regimes and predator-prey interactions, as is provided by wilderness and other protected wild lands, is another benefit of wilderness in large landscapes (Tabor et al 2013), like the Flathead NF.

The Forest Service, National Park Service, and US Fish and Wildlife Service recognize that protecting and connecting undeveloped areas is an important action agencies can take to enhance climate change adaptation. For example, the Forest Service National Roadmap for Responding to Climate Change (2011) establishes that increasing connectivity and reducing fragmentation are short and long term actions the Forest Service should take to facilitate adaptation to climate change.[22] The National Park Service also identifies connectivity as a key factor for climate change adaptation along with establishing "blocks of natural landscape large enough to be resilient to large-scale disturbances and long-term changes" and other factors. The agency states that: "The success of adaptation strategies will be enhanced by taking a broad approach that identifies connections and barriers across the landscape. Networks of protected areas within a larger mixed landscape can provide the highest level of resilience to climate change."[23] Similarly, the US Fish and Wildlife Service's National Fish and Wildlife Adaptation Strategy calls for creating an ecologically-connected network of conservation areas.[24]

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[22] Forest Service, 2011. *National Roadmap for Responding to Climate Change*. US Department of Agriculture. FS-957b. Page 26.

[23] National Park Service. *Climate Change Response Program Brief.* http://www.nature.nps.gov/climatechange/adaptationplanning.cfm. Also see: National Park Service, 2010. *Climate Change Response Strategy*. http://www.nature.nps.gov/climatechange/docs/NPS_CCRS.pdf. Objective 6.3 is to "Collaborate to develop cross-jurisdictional conservation plans to protect and restore connectivity and other landscape-scale components of resilience."

[24] See http://www.wildlifeadaptationstrategy.gov/pdf/NFWPCAS-Chapter-3.pdf. Pages 55-59. The first goal and related strategies are:

Goal 1: Conserve habitat to support healthy fish, wildlife, and plant populations and ecosystem functions in a changing climate.

Montanans value the wilderness that they have today and supported designation of new wilderness on the Flathead following the 1987 Flathead NF plan.

It has been thirty years since the last designation of Wilderness in Montana. While the conventional narrative describes wilderness designation as fraught with local politics and social dissent, the way that Montanans feel about wilderness appears to be much more positive.

In 2012, a bi-partisan survey of Montana voters to assess public attitudes about conservation issues was conducted by the polling firms of Fairbank, Maslin, Maullin, Metz & Associates (a Democratic firm) and Public Opinion Strategies (a Republican firm). This survey found that the protection of public lands was strongly supported by Montanans across political lines: “Voters strongly support policies to promote the conservation of National Forests – and oppose those that would jeopardize it.” (Metz 2012, 3) More than two-thirds of Montana voters supported proposed bills like the Rocky Mountain Front Heritage Act, the Forest Jobs and Recreation Act, and the North Fork Watershed Protection Act, while more than two- thirds opposed bills like the Wilderness Study and Roadless Area Release Act which would weaken protection of national forest lands.

Policy	TOTAL SUPPORT	Strong Support	Smwt Support	Total Oppose	DK/NA
The Forest Jobs and Recreation Act, a partnership with timber companies and conservation groups, which protects wilderness areas on three national forests, while also requiring the Forest Service to increase logging for jobs and forest health.	79%	40%	39%	17%	5%
The Rocky Mountain Front Heritage Act, which protects existing uses and access, and fights invasive weeds in the Lewis & Clark National Forest, while adding acreage to the Bob Marshall and Scapegoat wilderness areas.	72%	36%	36%	24%	4%
The North Fork Flathead Watershed Protection Act, which prohibits new mining and oil and gas leases on public land upstream from Flathead Lake and bordering Glacier Park, in order to protect water quality.	69%	43%	26%	27%	4%
The Wilderness Study and Roadless Release Act, which would remove existing protections for Montana's six million acres of undeveloped national forest backcountry, opening it up for motorized traffic, energy development, timber and mining.	38%	16%	22%	59%	3%
The National Security and Federal Lands Protection Act, which would give the Department of Homeland Security access and authority over public lands within 100 miles of the Canadian border, like Glacier National Park and Charles M. Russell National Wildlife Refuge.	27%	12%	15%	68%	5%

Figure 19. Support for Policies Related to National Forests in Montana (from Metz 2012, 4)

Strategy 1.1: identify areas for an ecologically-connected network of terrestrial, freshwater, coastal, and marine conservation areas that are likely to be resilient to climate change and to support a broad range of - fish, wildlife, and plants under changed conditions.

Strategy 1.2: Secure appropriate conservation status on areas identified in Strategy 1.1 to complete an ecologically-connected network of public and private conservation areas that will be resilient to climate change and support a broad range of species under changed conditions.

Strategy 1.4: Conserve, restore, and as appropriate and practicable, establish new ecological connections among conservation areas to facilitate fish, wildlife, and plant migration, range shifts, and other transitions caused by climate change.

Additionally, voters also overwhelmingly view wilderness protections as being beneficial to Montana, with more than 85% of Montanans seeing wilderness protections as being positive for the state. This outnumbers the percentage of voters seeing wilderness protections as bad for the state (11%) by a factor of seven. This positive view of the benefit of wilderness to Montana crossed party lines, geography, and recreational user groups:

- *95% of Democrats, 87% of independents, and 75% of Republicans;*
- *96% of liberals, 90% of moderates, and 77% of conservatives;*
- *91% of women and 79% of men;*
- *At least 82% of residents of Eastern, Central, and Western Montana; and*
- *87% of frequent mountain bikers, 72% of snowmobilers and 65% of motorized off-road vehicle users.*

(Metz 2012, 4)

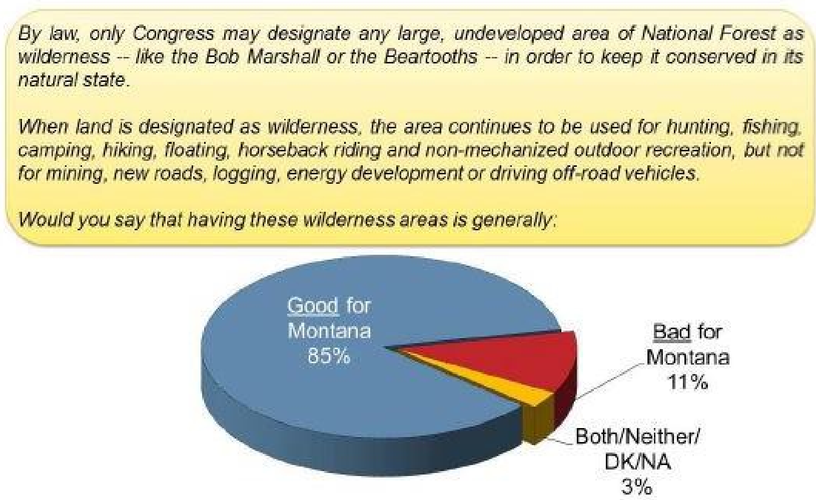

Figure 20. Perceived Impact of Wilderness Designations on Montana (Metz 2012, 5)

Since the 1987 Flathead NF plan, two bills that would have protected a significant portion of the Flathead NF's roadless lands progressed further than any other wilderness bills in Montana have since. The first, the 1988 Montana Wilderness bill, was taken successfully through a series of in-state public meetings, Congressional hearings and a full vote in Congress. It passed both the House and the Senate of the United States, but was pocket-vetoed by President Reagan in the waning days of his time in office. But for this overriding of Congressional approval, a number of the acres in the Flathead NF's roadless inventory would already be designated Wilderness today.

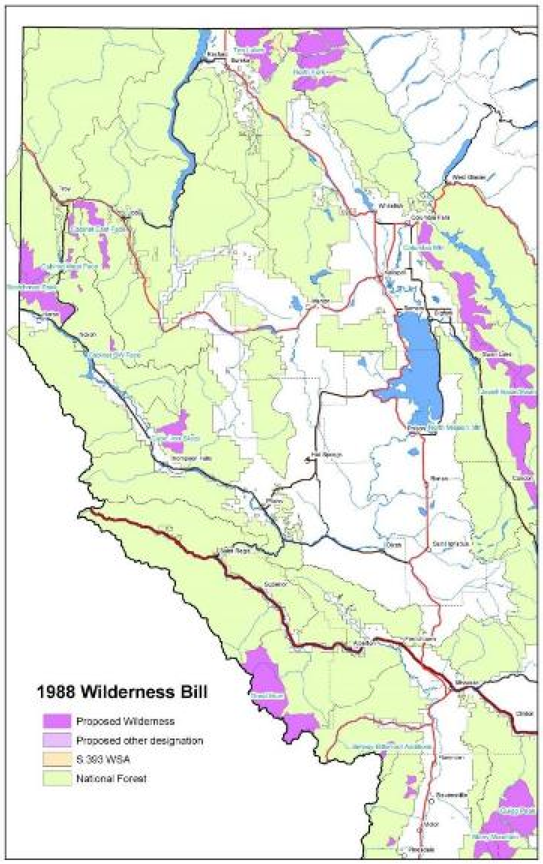

Figure 21. 1988 state-wide Wilderness bill for Montana. This bill included acres on the Flathead NF. It was passed out of both houses of the US Congress, then was pocket-vetoed by President Reagan. Map courtesy of Montana Wilderness Association.

Another bill, in 1994, likewise included substantial roadless acres in both the Swan Range and the Whitefish Range – two areas that should be prioritized for more detailed consideration for Recommended Wilderness in the forthcoming plan. This bill was passed by the US House of Representatives but stalled in the US Senate.

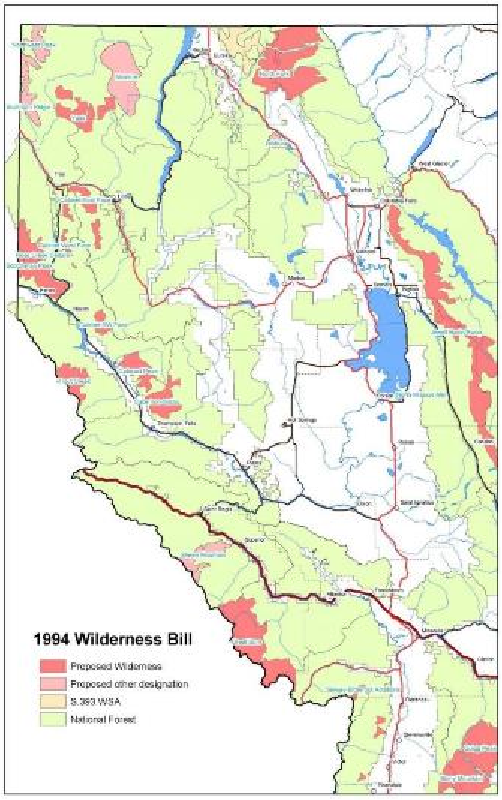

Figure 22. 1994 state-wide Wilderness bill for Montana. This bill included acres on the Flathead NF. It was passed by the US House but then stalled in the Senate. Map courtesy of Montana Wilderness Association.

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Protected Areas are a Benefit to Local Economies, including those around the Flathead NF

In addition to the Socio-economic Conditions and Trends data that the FNF included in its pre-Assessment information, when considering the need for new wilderness and other protective designations, we also hope you will take a closer look at the body of literature addressing the economic impacts of protected public lands, briefly summarized in Headwaters Economics' Protected Lands and Economics: *A Summary of Research and Careful Analysis on the Economic Impact of Protected Lands,* May 2013" and provided on their "Value of Protected Lands" webpage. (Headwaters 2013)

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Based on a wealth of existing rigorous and scientifically validated research, the general rule is that there is a neutral-to-positive relationship between the presence and extent of wilderness and other protected areas on one hand and the economic performance of local economies and the economic benefits available to nearby residents on the other. Here are just a few examples from this body of research:

- Protected public lands can and do play an important role in stimulating local economic growth, especially when combined with access to markets and an educated workforce, and are associated with some of the fastest growing communities in the West (Rasker 2006 and Rasker et al. 2009).

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- Wilderness designation enhances nearby private property value (Phillips 2004).

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- Wilderness and conservation lands are associated with rapid population, income, and employment growth relative to non-wilderness counties (Lorah and Southwick 2003; Lewis, Hunt and Plantinga 2002).

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- There is no evidence of job losses associated with wilderness and no evidence that counties more dependent on logging, mining, oil and gas suffered job losses as a result of wilderness designation in 250 non-urban counties in the Rocky Mountains (Duffy-Deno 1998).

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Headwaters Economics' recent report, West is Best: How Public Lands in the West Create a Competitive Economic Advantage, attributes much of Montana's economic growth and outpacing of many other U.S. states in recent years to the presence of protected public lands. Protected public lands positively impact employment in Western communities, showing steady increases in jobs as the percent of protected lands grows (as depicted below in Figure 23). For a national forest like the Flathead, where a significant portion of land is already protected, and for the communities that benefit from the forest, such studies may be particularly informative. These demonstrated increased economic benefits to local communities as the percentage of protected land base grows suggests that even a forest like the FNF should consider additional protective designations for their potential to confer additional economic benefits to local communities, in addition the ecological, water resource, and recreational benefits such designations would also provide.

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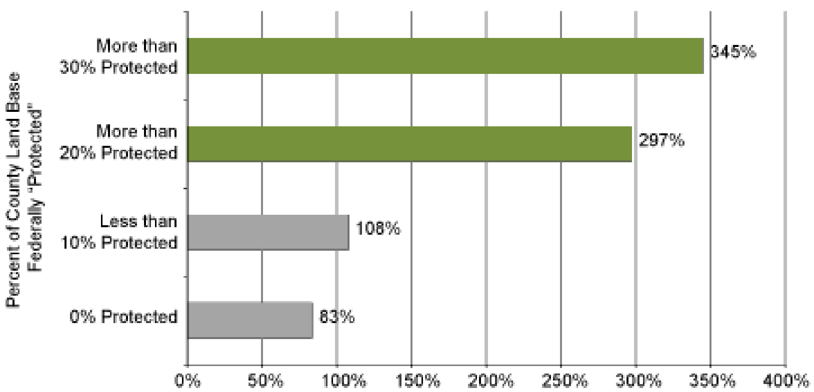

Figure 23. From 1970 to 2010, western non-metro counties with more than 30% of the county's land base in federal protected status increased jobs by 345%. As the share of federal lands in protected status goes down, the rate of job growth declines as well. Non-metro counties with no protected federal land increased jobs by 83%. Figure courtesy of Headwaters Economics. See more at: http://headwaterseconomics.org/land/west-is-best-value-of-public-lands-mt#sthash.YvtpYCH1.dpuf

Likewise, the Flathead NF should consider a new study forthcoming from Rasker et al (2013) about the increase in per capita income attributable to proximity to protected public lands.

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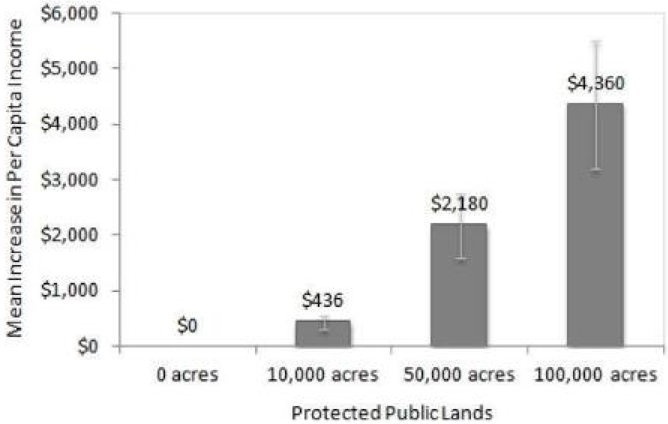

Figure 24. The effect of protected public lands on per capita income. The effect is demonstrated for four hypothetical non-metro counties that have 0, 10 thousand, 50 thousand, and 100 thousand acres of protected public lands. All else equal, the associated increase in income would be $0, $436, $2,180, and $4,360 per person. Confidence intervals are displayed with error bars. (Rasker et al 2013, 119)

IV. Process-related Considerations

There are several items that we would like the Flathead NF to consider as the plan revision proceeds, based on our experiences – both positive and negative -- in the early implementation of the 2012 planning rule and the Draft Directives on other national forests.

A. Given its importance in establishing the scientific foundation for the plan revision, we ask that you please release and provide for a comment period on the Flathead NF Draft Assessment, prior to finalizing it. The Flathead NF has already established a strong precedent for meaningful engagement by the public in the early stages of the plan revision, and we see the opportunity to review and provide comments on the Draft Assessment as an extension of this.

B. While appreciating the considerable effort you are putting into the Assessment for the plan revision, we ask that the Flathead NF not release a scoping document with a proposed action that is already constrained in its scope and options. Instead, we ask that you allow the major components of the plan to take shape after the initiation of the formal NEPA process, rather than defining elements of the plan revision prematurely. We believe that such an approach will help alleviate concerns among some citizens that collaborative efforts around forest plan revisions (indeed, around any national forest management planning and decisions) necessarily hamstring public involvement under the formal NEPA process. The Flathead NF should be able to implement and do right by both the new commitment under the planning rule to collaborate with the public throughout the process and the more traditional rubric for public involvement provided by NEPA.

C. Please note that the Planning Rule Federal Advisory Committee is providing recommendations for revisions to the Planning Rule Directives to the Secretary later this week; we will follow up with you on these in a subsequent communication.

D. Finally, we want to reiterate that we would like the Flathead NF to consider providing a scientific summary – similar to the California national forests undergoing plan revisions – that will identify the best available science forming the basis for the plan revision, so that citizens can be more informed about the foundation that underpins the forthcoming plan.

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V. Conclusion

While already part of an extraordinary national system of public lands, the Flathead NF nevertheless stands out as truly exceptional: home to one of the country's first and best wilderness areas, a complete complement of wildlife species, a source of clean air and water for growing local communities, and roadless areas that, if protected, can help safeguard these values for all Americans in an uncertain future.

We are similarly blessed with a wealth of information to help facilitate informed decisions about the future management of the Flathead NF that will ensure the forest's many resources can adapt to a rapidly changing climate and continue to provide extensive benefits and services to locals and visitors alike. We expect that the Asessment report will clearly identify a need and opportunity for additional designated areas on the Flathead NF, including recommended wilderness, and establish additional designated areas as an issue to be addressed in the plan revision.

We are pleased to have the chance to engage early and often with the Flathead NF staff and ID Team through the collaborative process you have established with the help of the Meridian Institute, and we are grateful for the opportunity to provide input on recent, best available science for consideration in the Assessment. Please let us know if you have any questions about our input or if you need assistance locating any of the references provided here.

We look forward to continuing to participate in the revision process on behalf of our members nationwide.

Sincerely,

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Attachment 1

Roaded Forests Are at a Greater Risk of Experiencing Wildfires than Unroaded Forests

- A wildland fire ignition is almost twice as likely to occur in a roaded area than in a roadless area. (USDA 2000, Table 3-18)
- The location of large wildfires is often correlated with proximity to busy roads. (Sierra Nevada Ecosystem Project, 1996)
- High road density increases the probability of fire occurrence due to human caused ignitions. (Hann, W.J., et al. 1997)
- Unroaded areas have lower potential for high-intensity fires than roaded areas because they are less prone to human-caused ignitions. (DelaSaia, et al. 1995)
- The median size of large fires on national forests is greater outside of roadless areas. (USDA 2000, Table 3-22)
- A positive correlation exists between lightning fire frequency and road density due to increased availability of flammable fine fuels near roads. (Arienti, M.Cecilia, et al. 2009)
- Human caused wildfires are strongly associated with access to natural landscapes, with the proximity to urban areas and roads being the most important factor (Romero-Calcerrada, et al. 2008)

For more information, contact Gregory H. Aplet, Ph.D., Senior Forest Scientist, at greg_aplet@tws.org or 303-650-5818 x104.

HUMAN ACTIVITY AND WILDFIRE

- Sparks from cars, off-road vehi- cles, and neglected campfires caused nearly 50,000 wildfire igni- tions in 2000. (USDA 2000, Fuel Management and Fire Suppression Specialist Report, Table 4.)
- More than 90% of fires on national lands are caused by humans (USDA 1996 and 1998)
- Human-ignited wildfire is almost 5 times more likely to occur in a roaded area than in a roadless ar- ea (USDA 2000, Table 3-19).

There are 375,000 miles of roads in our national forests.

THE WILDERNESS SOCIETY
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Attachment 2: Using Road Density as a Metric for Ecological Health in National Forests: What Roads and Routes should be Included?

Summary of Scientific Information

Last Updated, November 22, 2012

I. Density analysis should include closed roads, non-system roads administered by other jurisdictions (private, county, state), temporary roads and motorized trails.

Typically, the Forest Service has calculated road density by looking only at open system road density. From an ecological standpoint, this approach may be flawed since it leaves out of the density calculations a significant percent of the total motorized routes on the landscape. For instance, the motorized route system in the entire National Forest System measures well over 549,000 miles.[25] By our calculation, a density analysis limited to open system roads would consider less than 260,000 miles of road, which accounts for less than half of the entire motorized transportation system estimated to exist on our national forests.[26] These additional roads and motorized trails impact fish, wildlife, and water quality, just as open system roads do. In this section, we provide justification for why a road density analysis used for the purposes of assessing ecological health and the effects of proposed alternatives in a planning document should include closed system roads, non-system roads administered by other jurisdictions, temporary roads, and motorized trails.

Impacts of closed roads

It is crucial to distinguish the density of roads physically present on the landscape, whether closed to vehicle use or not, from "open-road density" (Pacific Rivers Council, 2010). An open-road density of 1.5 mi/mi² has been established as a standard in some national forests as protective of some terrestrial wildlife species. However, many areas with an open road density of 1.5 mi/mi² have a

[25] The National Forest System has about 372,000 miles of system roads. The forest service also has an estimated 47,000 miles of motorized trails. As of 1998, there were approximately 130,000 miles of non-system roads in our forests. Non- system roads include public roads such as state, county, and local jurisdiction and private roads. (USFS, 1998) The Forest Service does not track temporary roads but is reasonable to assume that there are likely several thousand miles located on National Forest System lands.

[26] About 30% of system roads, or 116,108 miles, are in Maintenance Level 1 status, meaning they are closed to all motorized use. (372,000 miles of NFS roads - 116,108 miles of ML 1 roads = 255,892). This number is likely conservative given that thousands of more miles of system roads are closed to public motorized use but categorized in other Maintenance Levels.

much higher inventoried or extant hydrologically effective road density, which may be several-fold as high with significant aquatic impacts. This higher density occurs because many road “closures” block vehicle access, but do nothing to mitigate the hydrologic alterations that the road causes. The problem is further compounded in many places by the existence of “ghost” roads that are not captured in agency inventories, but that are nevertheless physically present and causing hydrologic alteration (Pacific Watershed Associates, 2005).

Closing a road to public motorized use can mitigate the impacts on water, wildlife, and soils only if proper closure and storage technique is followed. Flow diversions, sediment runoff, and illegal incursions will continue unabated if necessary measures are not taken. The Forest Service’s National Best Management Practices for non-point source pollution recommends the following management techniques for minimizing the aquatic impacts from closed system roads: eliminate flow diversion onto the road surface, reshape the channel and streambanks at the crossing-site to pass expected flows without scouring or ponding, maintain continuation of channel dimensions and longitudinal profile through the crossing site, and remove culverts, fill material, and other structures that present a risk of failure or diversion. Despite good intentions, it is unlikely given our current fiscal situation and past history that the Forest Service is able to apply best management practices to all stored roads,[27] and that these roads continue to have impacts. This reality argues for assuming that roads closed to the public continue to have some level of impact on water quality, and therefore, should be included in road density calculations.

As noted above, many species benefit when roads are closed to public use. However, the fact remains that closed system roads are often breached resulting in impacts to wildlife. Research shows that a significant portion of off-road vehicle (ORV) users violates rules even when they know what they are (Lewis, M.S., and R. Paige, 2006; Frueh, LM, 2001; Fischer, A.L., et. al, 2002; USFWS, 2007.). For instance, the Rio Grande National Forest’s Roads Analysis Report notes that a common travel management violation occurs when people drive around road closures on Level 1 roads (USDA Forest Service, 1994). Similarly, in a recent legal decision from the Utah District Court , *Sierra Club v. USFS*, Case No. 1:09-cv-131 CW (D. Utah March 7, 2012), the court found that, as part of analyzing alternatives in a proposed travel management plan, the Forest Service failed to take a hard look at the impact of continued illegal use. In part, the court based its decision on the Forest Service’s acknowledgement that illegal motorized use is a significant problem and that the mere presence of roads is likely to result in illegal use.

In addition to the disturbance to wildlife from ORVs, incursions and the accompanying human access can also result in illegal hunting and trapping of animals. The Tongass National Forest refers to this in its EIS to amend the Land and Resources Management Plan. Specifically, the Forest Service notes in the EIS that Alexander Archipelego wolf mortality due to legal and illegal hunting and trapping is related not only to roads open to motorized access, but to all roads, and that *total road densities* of 0.7-1.0 mi/mi^2 or less may be necessary (USDA Forest Service, 2008).

[27] The Forest Service generally reports that it can maintain 20-30% of its open road system to standard.

As described below, a number of scientific studies have found that ORV use on roads and trails can have serious impacts on water, soil and wildlife resources. It should be expected that ORV use will continue to some degree to occur illegally on closed routes and that this use will affect forest resources. Given this, roads closed to the general public should be considered in the density analysis.

Impacts of non-system roads administered by other jurisdictions (private, county, state)

As of 1998, there were approximately 130,000 miles of non-system roads in national forests (USDA Forest Service, 1998). These roads contribute to the environmental impacts of the transportation system on forest resources, just as forest system roads do. Because the purpose of a road density analysis is to measure the impacts of roads at a landscape level, the Forest Service should include all roads, including non-system, when measuring impacts on water and wildlife. An all-inclusive analysis will provide a more accurate representation of the environmental impacts of the road network within the analysis area.

Impacts of temporary roads

Temporary roads are not considered system roads. Most often they are constructed in conjunction with timber sales. Temporary roads have the same types environmental impacts as system roads, although at times the impacts can be worse if the road persists on the landscape because they are not built to last.

It is important to note that although they are termed temporary roads, their impacts are not temporary. According to Forest Service Manual (FSM) 7703.1, the agency is required to "Reestablish vegetative cover on any unnecessary roadway or area disturbed by road construction on National Forest System lands within 10 years after the termination of the activity that required its use and construction." Regardless of the FSM 10-year rule, temporary roads can remain for much longer. For example, timber sales typically last 3-5 years or more. If a temporary road is built in the first year of a six year timber sale, its intended use does not end until the sale is complete. The timber contract often requires the purchaser to close and obliterate the road a few years after the Forest Service completes revegetation work. The temporary road, therefore, could remain open 8-9 years before the ten year clock starts ticking per the FSM. Therefore, temporary roads can legally remain on the ground for up to 20 years or more, yet they are constructed with less environmental safeguards than modern system roads.

Impacts of motorized trails

Scientific research and agency publications generally do not decipher between the impacts from motorized trails and roads, often collapsing the assessment of impacts from unmanaged ORV use with those of the designated system of roads and trails. The following section summarizes potential impacts resulting from roads and motorized trails and the ORV use that occurs on them.

Aquatic Resources

While driving on roads has long been identified as a major contributor to stream sedimentation (for review, see Gucinski, 2001), recent studies have identified ORV routes as a significant cause of stream sedimentation as well (Sack and da Luz, 2004; Chin et al.; 2004, Ayala et al.; 2005, Welsh et al;. 2006). It has been demonstrated that sediment loss increases with increased ORV traffic (Foltz, 2006). A study by Sack and da Luz (2004) found that ORV use resulted in a loss of more than 200 pounds of soil off of every 100 feet of trail each year. Another study (Welsh et al., 2006) found that ORV trails produced five times more sediment than unpaved roads. Chin et al. (2004) found that watersheds with ORV use as opposed to those without exhibited higher percentages of channel sands and fines, lower depths, and lower volume – all characteristics of degraded stream habitat.

Soil Resources [28]

Ouren, et al. (2007), in an extensive literature review, suggests ORV use causes soil compaction and accelerated erosion rates, and may cause compaction with very few passes. Weighing several hundred pounds, ORVs can compress and compact soil (Nakata et al., 1976; Snyder et al., 1976; Vollmer et al., 1976; Wilshire and Nakata, 1976), reducing its ability to absorb and retain water (Dregne, 1983), and decreasing soil fertility by harming the microscopic organisms that would otherwise break down the soil and produce nutrients important for plant growth (Wilshire et al., 1977). An increase in compaction decreases soil permeability, resulting in increased flow of water across the ground and reduced absorption of water into the soil. This increase in surface flow concentrates water and increases erosion of soils (Wilshire, 1980; Webb, 1983; Misak et al., 2002).

Erosion of soil is accelerated in ORV-use areas directly by the vehicles, and indirectly by increased runoff of precipitation and the creation of conditions favorable to wind erosion (Wilshire, 1980). Knobby and cup-shaped protrusions from ORV tires that aid the vehicles in traversing steep slopes are responsible for major direct erosional losses of soil. As the tire protrusions dig into the soil, forces far exceeding the strength of the soil are exerted to allow the vehicles to climb slopes. The result is that the soil and small plants are thrown downslope in a “rooster tail” behind the vehicle. This is known as mechanical erosion, which on steep slopes (about 15° or more) with soft soils may erode as much as 40 tons/mi (Wilshire, 1992). The rates of erosion measured on ORV trails on moderate slopes exceed natural rates by factors of 10 to 20 (Iverson et al., 1981; Hinckley et al., 1983), whereas use on steep slopes has commonly removed the entire soil mantle exposing bedrock. Measured erosional losses in high use ORV areas range from 1.4-242 lbs/ft^2 (Wilshire et al., 1978) and 102-614 lbs/ft^2 (Webb et al., 1978). A more recent study by Sack and da Luz (2003) found that ORV use resulted in a loss of more than 200 lbs of soil off of every 100 feet of trail each year.

Furthermore, the destruction of cryptobiotic soils by ORVs can reduce nitrogen fixation by cyanobacteria, and set the nitrogen economy of nitrogen-limited arid ecosystems back decades. Even small reductions in crust can lead to diminished productivity and health of the associated plant community, with cascading effects on plant consumers (Davidson et al., 1996). In

[28] For a full review see Switalski, T. A. and A. Jones (2012).

general, the deleterious effects of ORV use on cryptobiotic crusts is not easily repaired or regenerated. The recovery time for the lichen component of crusts has been estimated at about 45 years (Belnap, 1993). After this time the crusts may appear to have regenerated to the untrained eye. However, careful observation will reveal that the 45 year-old crusts will not have recovered their moss component, which will take an additional 200 years to fully come back (Belnap and Gillette, 1997).

Wildlife Resources [29]

Studies have shown a variety of possible wildlife disturbance vectors from ORVs. While these impacts are difficult to measure, repeated harassment of wildlife can result in increased energy expenditure and reduced reproduction. Noise and disturbance from ORVs can result in a range of impacts including increased stress (Nash et al., 1970; Millspaugh et al., 2001), loss of hearing (Brattstrom and Bondello, 1979), altered movement patterns (e.g., Wisdom et al. 2004; Preisler et al. 2006), avoidance of high-use areas or routes (Janis and Clark 2002; Wisdom 2007), and disrupted nesting activities (e.g., Strauss 1990).

Wisdom et al. (2004) found that elk moved when ORVs passed within 2,000 yards but tolerated hikers within 500 ft. Wisdom (2007) reported preliminary results suggesting that ORVs are causing a shift in the spatial distribution of elk that could increase energy expenditures and decrease foraging opportunities for the herd. Elk have been found to readily avoid and be displaced from roaded areas (Irwin and Peek, 1979; Hershey and Leege, 1982; Millspaugh, 1995). Additional concomitant effects can occur, such as major declines in survival of elk calves due to repeated displacement of elk during the calving season (Phillips, 1998). Alternatively, closing or decommissioning roads has been found to decrease elk disturbance (Millspaugh et al., 2000; Rowland et al., 2005).

Disruption of breeding and nesting birds is particularly well-documented. Several species are sensitive to human disturbance with the potential disruption of courtship activities, over-exposure of eggs or young birds to weather, and premature fledging of juveniles (Hamann et al., 1999). Repeated disturbance can eventually lead to nest abandonment. These short-term disturbances can lead to long-term bird community changes (Anderson et al., 1990). However when road densities decrease, there is an observable benefit. For example, on the Loa Ranger District of the Fishlake National Forest in southern Utah, successful goshawk nests occur in areas where the localized road density is at or below 2-3 mi/mi^2 (USDA, 2005).

Examples of Forest Service planning documents that use total motorized route density or a variant

Below, we offer examples of where total motorized route density or a variant has been used by the Forest Service in planning documents.

[29] For a full review see:Switalski, T. A. and A. Jones (2012).

- The Mt. Taylor RD of the Cibola NF analyzed open and closed system roads and motorized trails together in a single motorized *route* density analysis. Cibola NF: Mt. Taylor RD Environmental Assessment for Travel Management Planning, Ch.3, p 55. http://prdp2fs.ess.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5282504.pdf.

- The Grizzly Bear Record of Decision (ROD) for the Forest Plan Amendments for Motorized Access Management within the Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones (Kootenai, Lolo, and Idaho Panhandle National Forests) assigned route densities for the designated recovery zones. One of the three densities was for Total Motorized Route Density (TMRD) which includes open roads, restricted roads, roads not meeting all reclaimed criteria, and open motorized trails. The agency's decision to use TMRD was based on the Endangered Species Act's requirement to use best available science, and monitoring showed that both open and closed roads and motorized trails were impacting grizzly. Grizzly Bear Plan Amendment ROD. Online at cache.eco system-m anagement.o rg / 48 53 6_FSPLT1_0 09 72 0 .pdf .

- The Chequamegon-Nicolet National Forest set forest-wide goals in its forest plan for both open road density and total road density to improve water quality and wildlife habitat.

I decided to continue reducing the amount of total roads and the amount of open road to resolve conflict with quieter forms of recreation, impacts on streams, and effects on some wildlife species. ROD, p 13.

Chequamegon-Nicolet National Forest Land and Resource Management Plan Record of Decision. Online at http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5117609.pdf.

- The Tongass National Forest's EIS to amend the forest plan notes that Alexander Archipelago wolf mortality due to legal and illegal hunting and trapping is related not only to roads open to motorized access, but to all roads, and that *total road densities* of 0.7-1.0 mi/mi^2 or less may be necessary.

Another concern in some areas is the potentially unsustainable level of hunting and trapping of wolves, when both legal and illegal harvest is considered. The 1997 Forest Plan EIS acknowledged that open road access contributes to excessive mortality by facilitating access for hunters and trappers. Landscapes with open-road densities of 0.7 to 1.0 mile of road per square mile were identified as places where human- induced mortality may pose risks to wolf conservation. The amended Forest Plan requires participation in cooperative interagency monitoring and analysis to identify areas where wolf mortality is excessive, determine whether the mortality is unsustainable, and identify the probable causes of the excessive mortality.

More recent information indicates that wolf mortality is related not only to roads open to motorized access, but to all roads, because hunters and trappers use all roads to access wolf habitat, by vehicle or on foot. Consequently, this decision amends the pertinent standard and guideline contained in Alternative 6 as displayed in the Final EIS in areas where road access and associated human caused mortality has been determined to be the significant contributing factor to unsustainable wolf mortality. The standard and guideline has been modified to ensure that a range of options to reduce mortality risk will be considered in these areas, and to specify that total road densities of 0.7 to 1.0 mile per square mile or less may be necessary. ROD, p 24.

Tongass National Forest Amendment to the Land and Resource Management Plan Record of Decision and Final EIS. January 2008. http://tongass-fpadjust.net/Documents/Record_of_Decision.pdf

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Attachment 3: Annotated Bibliography on Ecological Benefits of Wilderness and Protected Areas

Anderson et al, 2012. Watershed Health in Wilderness, Roadless, and Roaded Areas of the National Forest System. The Wilderness Society, Washington DC.
http://wilderness.org/resource/watershed-health-wilderness-roadless-and-roaded-areas-national-forest-system

The Wilderness Society used the first round of watershed condition assessment data from the Forest Service's Watershed Condition Framework to assess the relationship of watershed condition and land management status. Using a standardized assessment method, the Forest Service in 2010 assessed the condition of more than 15,000 individual 6th HUC watersheds across the National Forest System, and categorized them as properly functioning, functioning at risk, and impaired. Anderson et al overlaid the three watershed condition classes with three broad land management designations – Wilderness, Inventoried Roadless Areas, and roaded areas – and found a strong spatial association between watershed health and protective designations. This finding is consistent with previous scientific studies of aquatic resources in roaded and unroaded landscapes.

Arcese and Sinclair 1997. "The Role of Protected Areas as Ecological Baselines." The Journal of Wildlife Management, Vol. 61, No. 3, pp. 587-602.
The authors argue for managing a representative number of protected areas as ecological baseline controls to help in understanding the effects of humans worldwide, and thus to enhance our ability to manage natural resources for a wide range of goals. To aid in evaluating human influences, areas less modified by humans are needed to use as de facto control sites. The authors suggest that the highest value of man protected areas will be realized when they are managed as ecological baseline controls.

Crist, Michelle and Wilmer, B., 2002. "Roadless Areas: The Missing Link in Conservation." The Wilderness Society.

The authors examine the contributions of Forest Service roadless areas to conservation in the Northern Rockies. They show that protection of national forest roadless areas, when added to existing federal conservation lands in the study area, will:

- Increase the representation of virtually all land cover types on conservation lands at both the regional and ecosystem scales, some by more than 100%.
- Help protect rare, species-rich, and often-declining vegetation communities. The protection of roadless lands would increase representation of the aspen community on conservation lands by 480% and the western hemlock community by 603%.
- Protect one vegetation community—bur oak woodland—that is not currently represented on existing conservation lands.
- Help protect lower-elevation lands—and their communities of species—that have been greatly altered by road construction, settlements, and resource extraction.
- Connect conservation units, many of which were established for their scenic and recreation values and not as wildlife habitat, to create bigger and more cohesive habitat "patches."

DellaSala, D., J. Karr, and D. Olson, 2011. "Roadless areas and clean water." Journal of Soil and Water Conservation, vol. 66, no. 3. May/June 2011.

The authors review the importance of inventoried roadless areas on national forests in the United States, concluding that: 1) many intact watersheds are in headwaters, 2) they supply downstream users with high-quality drinking water, and 3) developing these watersheds comes at significant costs associated with declining water quality and availability. They cite a study by Loomis (1998) that found that the cost savings to water treatment plants and highway departments from avoiding sedimentation caused by logging in inventoried roadless area watersheds is estimated at up to $18 billion annually. The authors recommend a light-touch ecological footprint to sustain the many values that derive from roadless areas, especially clean and abundant water.

DeVelice and Martin, 2001. "Assessing the Extent to which Roadless Areas Complement the Conservation of Biological Diversity." Ecological Applications. 11(4), 2001, pp. 1008-1018.

Assessed the extent to which inventoried roadless areas (IRAs) on USDA Forest Service lands contain biophysical features that complement the conservation reserve network (e.g., national parks, designated wilderness areas, and wildlife refuges) in the United States. Of the 83 ecoregions evaluated in the United States, 28 have 12% of their total area in conservation reserves. If IRAs are considered with conservation reserves, the number of ecoregions exceeding the 12% threshold increases from 28 to 32. When only national forest land in the ecoregions is considered, the area of designated wilderness exceeds 12% in 18 of the 45 ecoregions summarized. If IRAs are considered along with designated wilderness, the number of ecoregions exceeding the 12% threshold increases from 18 to 32. These results highlight the contribution that IRAs could make toward building a representative network of conservation reserves in the United States. Including these areas as reserves would expand ecoregional representation, increase the area of reserves at lower elevations, and increase the number of areas large enough to provide refugia for species needing large tracts relatively undisturbed by people.

Loucks et al, 2003. "USDA Forest Service Roadless Areas: Potential Biodiversity Conservation Reserves." Conservation Ecology 7(2): 5. http://www. Consecol.org/vol7/iss2/art5.

Examined the potential contributions of Inventoried Roadless Areas to the conservation of biodiversity. Found that more than 25% of IRAs are located in globally or regionally outstanding ecoregions and that 77% of inventoried roadless areas have the potential to conserve threatened, endangered, or imperiled species. IRAs would increase the conservation reserve network containing these species by 156%. Also looked at the conservation potential of IRAs by highlighting their contribution to the conservation of the grizzly bear (*Ursos arctos*), a wide-ranging carnivore. The area created by the addition of IRAs to the existing system of conservation reserves shows a strong concordance with grizzly bear recovery zones and habitat range. Conclude that IRAs belonging to the U.S. Forest Service are one of the most important biotic areas in the nation, and that their status as roadless areas could have lasting and far-reaching effects for biodiversity conservation.

Wilcove, David. 1990. "Natural Resources and Environmental Issues." Natural Resources and Environmental Issues: Vol. 0, Article 7.

Asserts that one of the strongest arguments in support of Wilderness is the preservation of biodiversity. Wild areas are reservoirs of biodiversity in this country, and their value increases as the volume of unprotected wildlands diminishes with development. He criticizes recent arguments the wilderness preservation is counterproductive to good wildlife management, arguing that most of the

ecological arguments against Wilderness are unsubstantiated or inaccurate, and the Wilderness Act provides the necessary flexibility to address the major management issues that are likely to arise.

The Wilderness Society, 2004. "Landscape Connectivity: An Essential Element of Land Management." Science and Policy Brief, Number 1. The Wilderness Society. Washington DC.

The document summarized the importance of landscape connectivity to biodiversity, concluding that:

- Loss of habitat connections across a landscape is one of the most severe threats to the survival of many wildlife species.
- Each species has evolved different needs for connectivity; to help sustain viable populations, it is essential to understand those specific needs.
- Conservation ecologists are focusing on: (1) protection of corridors that link isolated habitat patches and (2) maintenance of natural conditions in the "matrix" (land surrounding intact habitat) to ensure sufficient landscape connectivity.

Attachment 4: Annotated Bibliography on Economic Benefits of Protected Public Lands

Several studies discuss the forces behind the changing economy of much of rural America. Many of these studies attribute strong economic and population growth to "lifestyle migrants." These are residents who either rely on investment or retirement income or who have businesses or employment which is not tied to a particular location. These migrants seek locations with high levels of amenities, including those that are associated with an abundance of protected public lands such as wilderness and national monuments.

Commented [kmg133]: We have included literature on this topic in our assessment. The literature below is similar to what was used.

Berrens, R., J. Talberth, J. Thacher, M. Hand. 2006. *Economic and Community Benefits of Protecting New Mexico's Inventoried Roadless Areas*. Sante Fe, NM: Center for Sustainable Economy. 69 pp. Available online at http://www.sustainable-economy.org/main/send_client_files?f=Final%2520Report.pdf.

Berrens et al. (2006) examine several categories of non-market economic values associated with the 1.6 million acres of inventoried roadless areas on National Forests in New Mexico. These authors use specific data on roadless area size and characteristics, data on the economic values of recreation in New Mexico, the economic value of clean water and other non-market values to estimate the total annual value of retaining the wilderness character associated with inventoried roadless areas: "Annual economic benefits range up to $42 million for maintenance of water quality, $24 million for carbon sequestration, $26 million for outdoor recreation, $14 million for passive uses, and $1.4 million in enhanced property values. Annual community effects range up to 938 jobs and $23 million in personal income." (p. 3)

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Duffy-Deno, K.T. 1998. The effect of federal wilderness on county growth in the intermountain western United States. *Journal of Regional Science*. 38(1):109-136.

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Duffy-Deno (1998) examines 250 non-urban counties in the eight intermountain west states. He finds that there is no evidence that the existence of federal wilderness is directly or indirectly associated with population or employment changes in these counties. The study also finds that there is no evidence that wilderness has any affect on resource extraction employment in these western counties.

Holmes, F. P. and W.E. Hecox. 2004. Does wilderness impoverish rural regions? *International Journal of Wilderness*. 10(3): 34-39. Available online at http://www.wilderness.net/library/documents/IJWDec04_Holmes.pdf.

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In a study of 113 rural Western Counties, Holmes and Hecox (2004) find a positive correlation between the percent of land in designated wilderness and population, income and employment growth. They also find that wilderness is correlated with higher growth in investment income and entrepreneurial activity.

Loomis, J.B. and R. Richardson. 2000. Economic Values of Protecting Roadless Areas in the United States. Prepared for The Wilderness Society and Heritage Forests Campaign. 44pp. Available online at http://www.sierraforestlegacy.org/Resources/Conservation/FireForestEcology/ForestEconomics/Economics-Loomis00.pdf.

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According to research by Loomis and Richardson (2000), the 42 million acres of roadless lands "…can be expected to provide almost $600 million in recreation benefits each year, more than $280 million in passive use values, and nearly 24,000 jobs. (p. iii)" In additions, these research find that roadless

areas also produce between $490 million and $1 billion in carbon sequestration services and $490 million in waste treatment services.

Loomis, J.B. 2000. Economic values of wilderness recreation and passive use: What we think we know at the beginning of the 21st century. In: McCool, Stephen F.; Cole, David N.; Borrie, William T.; O'Loughlin, Jennifer, comps. 2000. Wilderness science in a time of change conference—Volume 2: Wilderness within the context of larger systems; 1999 May 23–27;Missoula, MT. Proceedings RMRS-P-15-VOL-2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 5-13. Available online at http://www.fs.fed.us/rm/pubs/rmrs_p015_2/rmrs_p015_2_005_013.pdf.

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Loomis (2000) estimates that the value of recreation on all U.S. wilderness lands is $574 million per year. The economic value of Western wilderness (not including Alaska) is estimated to be $168/acre or $7 billion per year. The economic value of Eastern wilderness is $468 million annually.

Lorah, P.A. 2000. Population growth, economic security, and cultural change in wilderness counties. In: McCool, Stephen F.; Cole, David N.; Borrie, William T.; O'Loughlin, Jennifer, comps. 2000. Wilderness science in a time of change conference—Volume 2: Wilderness within the context of larger systems; 1999 May 23–27;Missoula, MT. Proceedings RMRS-P-15-VOL-2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 230-237. Available online at http://www.fs.fed.us/rm/pubs/rmrs_p015_2/rmrs_p015_2_230_237.pdf.

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Counter to many people's beliefs, Lorah (2000) finds that counties with wilderness showed growth in income, population and employment. He also finds that the presence of wilderness in these counties has also helped them to diversify economies that had been stagnant due to over-reliance on declining resource extraction industries.

Phillips, S. 2000. Windfalls for wilderness: Land protection and land value in the Green Mountains. In: McCool, Stephen F.; Cole, David N.; Borrie, William T.; O'Loughlin, Jennifer, comps. 2000. Wilderness science in a time of change conference—Volume 2: Wilderness within the context of larger systems; 1999 May 23–27;Missoula, MT. Proceedings RMRS-P-15-VOL-2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 258-267. Available online at http://www.wilderness.net/library/documents/Phillips_2-33.pdf.

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Final results described in Phillips, S. 2004.Windfalls for Wilderness: Land Protection and Land Value in the Green Mountains. Ph.D. Dissertation. Virginia Polytechnic Institute and State University, Blacksburg, VA. (A summary of the doctoral thesis is provided in The Economic Benefits of Wilderness: Focus on Property Value Enhancement, Wilderness Society Science and Policy Brief, no. 2, March 2004. 8 pages.)

Data on land sales near Green Mountain National Forest wilderness areas show that the presence of wilderness areas, proximity to these wilderness areas and the extent of the wilderness areas each is associated with higher residential property values.

Rosenberger, R.S. and D.B.K. English 2005. Impacts of Wilderness on Local Economic Development. In: Cordell, H.K., J.C. Bergstrom and J.M. Bowker (eds). The Multiple Values of Wilderness. Venture Publishing: State College, PA.

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While wilderness recreation generates some economic activity for local communities, the more important impact lies in what Rosenberger and English (2005) call a "wilderness-related advantage." They cite several research studies which together indicate that rural counties with wilderness or

other protected federal lands experience greater population and economic growth than those without wilderness.

Rudzitis, G. and R. Johnson. 2000. The impact of wilderness and other wildlands on local economies and regional development trends. In: McCool, Stephen F.; Cole, David N.; Borrie, William T.; O'Loughlin, Jennifer, comps. 2000. Wilderness science in a time of change conference—Volume 2: Wilderness within the context of larger systems; 1999 May 23–27;Missoula, MT. Proceedings RMRS-P-15-VOL-2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 14-26. Available online at http://www.wilderness.net/library/documents/science1999/Volume2/Rudzitis_2-4.pdf.

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This study (Rudzitis and Johnson 2000) also finds that while wilderness recreation benefits to local communities are modest, the presence of wilderness appears to draw residents and new economic activity that does have a substantial positive impact

CENTER FOR LARGE LANDSCAPE CONSERVATION

21 February 2014

Joe Krueger
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Flathead National Forest
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Kalispell, MT 59901

Re: Connectivity in the Forest Assessment for the Flathead Forest Plan Revision

Dear Joe,

As the Flathead National Forest (FNF) continues to engage the public during the assessment phase of the revision process for its Land Resources Management Plan ("Plan") we would like to provide comments and information to help support your evaluation of connectivity, given the new requirements for connectivity under the Forest Service's planning regulations.

The new Rule and its implementing regulations create an opportunity to assess connectivity as a key component to maintain ecological integrity and to further promote connectivity as a strategy that addresses climate adaptation for plants and wildlife. Connectivity can be evaluated both within the FNF and between the forest and adjoining lands important to fauna and flora.

Who is CLLC

Focused on the American West, The Center for Large Landscape Conservation (CLLC) catalyzes,

Center For Large Landscape Conservation
P.O. Box 1587, Bozeman, MT 59771
www.climateconservation.org

advances, and supports large landscape conservation by:
• building communities of invested stakeholders around large landscape issues,
• advocating policies and strategies that champion ecological connectivity, and
• advancing science that informs critical decision making.

CLLC was established in 2007 and is a nonprofit corporation located in Bozeman, Montana. We provided comments focused solely on ecological connectivity during the development of the new Forest Planning Rule and are pleased that new direction for connectivity is now to be a part of forest plan revisions across the country. As a result, CLLC is interested in participating in Forest-level plan revisions to determine how the new national policy and its provisions for addressing connectivity will be translated into each new forest plan. We think the Forest Service's next generation of management plans can make a great leap forward to assure ecological connectivity is part and parcel of the management of our public lands.

A Look at Other Forests Approach to Connectivity

Several other national forests have been developing their plan revisions and have sought to address the new connectivity issue. These might help inform the FNF and its approach in the Assessment and ultimately in the FNF's revised plan.

The Sierra National Forest recently completed its Forest Assessment (SNF 2014) which included many types of connectivity evaluations such as least cost path (LCP) corridor analyses for forest carnivores, LCPs between old growth/late successional forest patches, and LCPs among large blocks of relatively intact landscape (Figure 1). Similar forest-wide analyses are available to the FNF for its Assessment and Forest Plan Revision which we will discuss below.

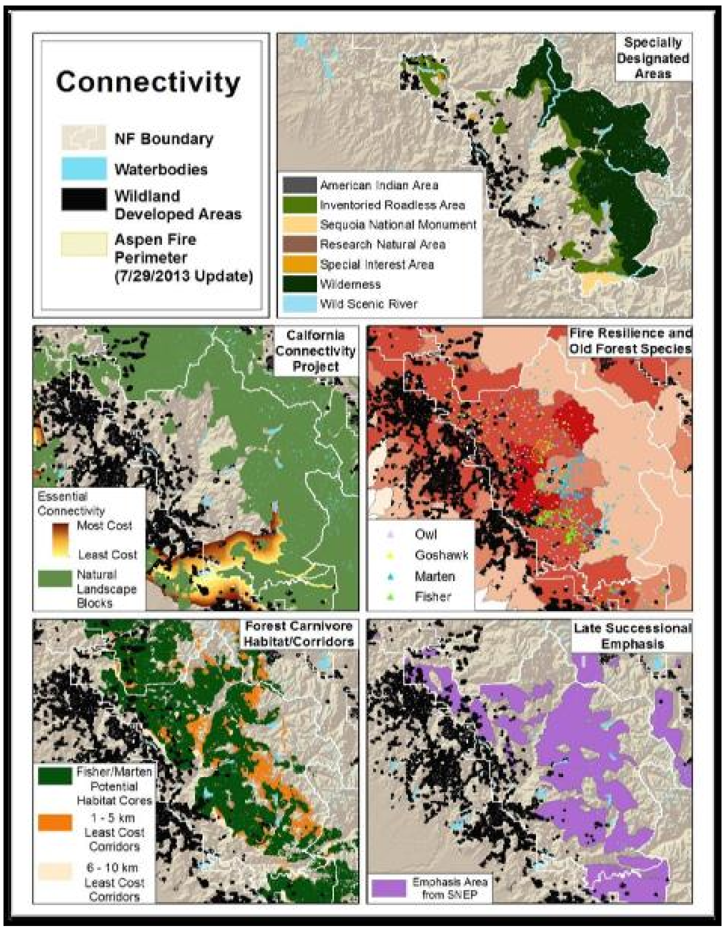

Figure 1. Key sources of information on connectivity from the Sierra NF's Assessment (SNF 2014).

In a paper prepared to describe the important factors to address for connectivity in the Okanagan,Wenatchee and Colville National Forests Plan Revisions in northeast Washington, Gaines (2012) describes key issues that influence connectivity. Two of these key issues identified in the Gaines paper are the density of motorized travel routes and the locations of highways and other high speed roads. It would be helpful if the FNF could do this in its Assessment, given the known impacts of open roads and recreational trails to focal species such as grizzly bears, elk, and many other species on the FNF. High speed roads through or adjacent to the FNF lands also have identifiable or relative "hot spots" of wildlife mortality, where spatial data is readily available from the Montana Department of Transportation. Other factors that may influence connectivity or create barriers for movement by wildlife on the FNF by the transportation system and motorized recreation trails should be analyzed and included in the Assessment in addition to road mortality, such as road and motorized trail densities, etc.

Connectivity Studies and Information Available for the FNF's Assessment and Plan Revision

The purpose of this summary is to suggest that the following resources be considered by the FNF Plan Revision Team as key components of the best available scientific information (BASI) pertaining to connectivity in and around the FNF. The current assessment background document, Wildlife Information for Desired Condition Discussion, offers two maps of mature forest cover in the FNF, and Appendices E and F offer additional details pertaining to coarse-filter and fine-filter indicators anticipated by the Plan Revision Team to inform management of Desired Condition for Wildlife on the FNF. While these information sources address many of the primary habitat needs of focal species and the maintenance of ecological processes, we suggest that they do not adequately address wildlife connectivity in and around the FNF. We recommend utilization of the following additional sources of scientific information pertaining explicitly to connectivity in order to fully support wildlife movement and continuity of ecological processes on the FNF. We emphasize how each may help to prioritize key linkage zones (specific geographies where the protection of connectivity should be a management priority) within the FNF and guide development of a revised management plan that fully supports connectivity based on the best available scientific information.

A. *Landscape integrity-based connectivity models*. Two connectivity models designed to predict key corridors among intact blocks of natural habitat are available for the Flathead region. These models are not species-specific; instead, they serve as a coarse-filter approach to identifying areas expected to support movement of a wide range of species as well as continuity of ecological processes.

Both models are intended to provide a first-pass, "20,000 feet" view of areas expected to be important for connectivity, and should not form the basis for fine-scale, site level management decisions. Instead, these models can help to guide selection of general areas within which to prioritize collection and/or use of finer-scale data.

While both models were designed with the same concept in mind, they employ different methodology, encompass different geographic extents, and are presented in different forms. Therefore, while similarities exist, predictions of key corridors from each model will often disagree, particularly at finer scales. We suggest that both models offer a potentially valuable perspective on priorities in managing for connectivity, and that both should be considered, alongside other resources described below.

1. The Montana Department of Fish, Wildlife & Parks (FWP) has produced the Crucial Areas Planning System (CAPS) as part of the Western Governors' Association Wildlife Corridors and Crucial Habitat Initiative. FWP's Crucial Areas Assessment evaluated Montana's fish, wildlife and recreational resources in order to identify crucial areas and fish and wildlife corridors. The Assessment created digital GIS-layer maps depicting important species and habitat information, including statewide connectivity surfaces for forest generalist and forest specialist species. Connectivity layers were created using least cost corridor methods to model corridors between large landscape blocks, or primary habitat patches.

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Please note that while original connectivity analyses conducted by FWP assigned connectivity scores of 1-100, these values were subsequently condensed into scores of 1-6 for release to the public via CAPS. Because these groupings are coarse and do not carry clear ecological meaning in terms of the connectivity needs of individual species, we strongly recommend use of the original, more detailed connectivity layers from FWP for the purposes of Plan revision (Figure 2). Use of these layers will enable consideration of the connectivity needs of more sensitive forest specialist species as well as prioritization of efforts to maintain connectivity within the Flathead NF, neither of which are possible using the coarsened public release of these analyses via CAPS.

For questions concerning access to and use of data from FWP's full connectivity analyses, please contact Adam Messer (406.444.0095, amesser@mt.gov). For more information about the CAPS connectivity assessment, please contact Paul Sihler (406.444.3196, psihler@mt.gov) with program and policy questions, or Dawn Anderson (406.444.3373, dawanderson@mt.gov) with technical or data questions.

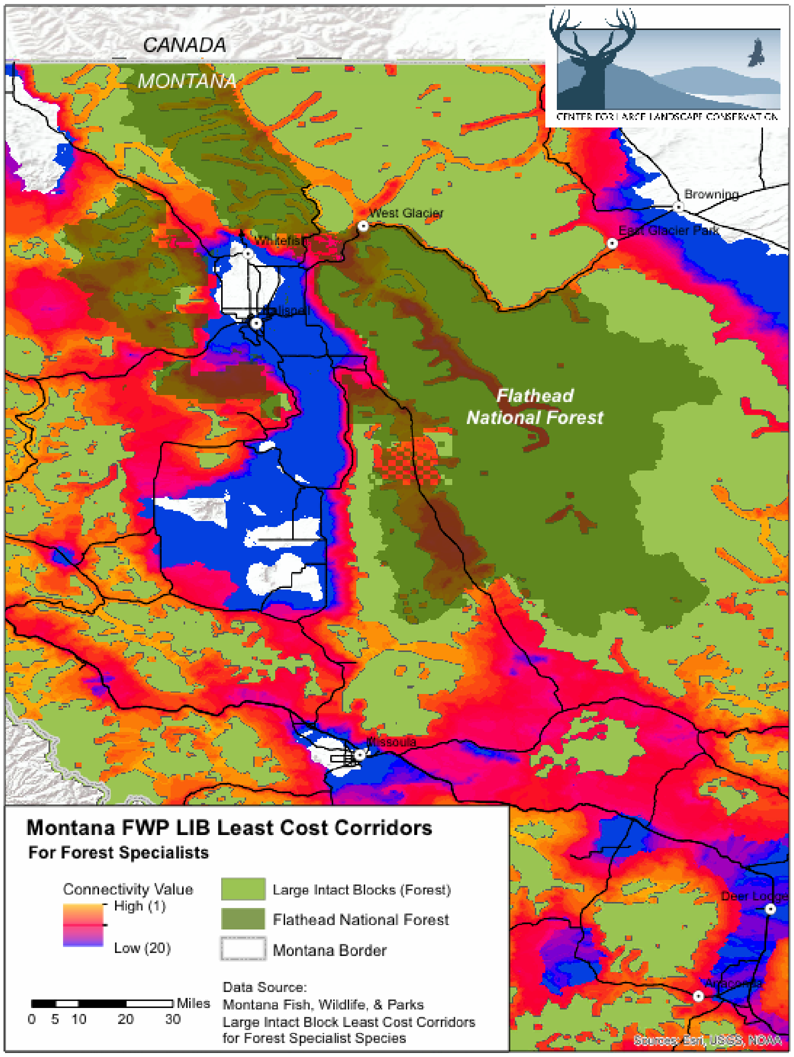

Figure 2. Large Landscape Block least cost path analysis for forest specialists, MT FWP.

2. The Western Governors' Association has produced a west-wide Crucial Habitat Assessment Tool (CHAT) as part of its Wildlife Corridors and Crucial Habitat Initiative. The CHAT is a cooperative effort of 16 Western states to provide the public and industry a high-level overview of "crucial habitat" across the West. "Crucial habitats" are places that are likely to provide the natural resources important to aquatic and terrestrial wildlife, including species of concern, as well as hunting and fishing species. The west-wide CHAT is intended to help users in the pre-planning of energy corridors and transmission routes, or in comparing fish and wildlife habitat, by establishing a common starting point across the West for the intersection of development and wildlife.

As part of the WGA's CHAT effort, connectivity among large intact blocks of habitat was modeled throughout the West. These models identify centrality flow lines, or corridor routes predicted to be crucial for maintaining broad-scale connectivity of several major biomes, including forested systems (Figure 3). Although this analysis was conducted throughout the west, individual states adopted it at their own discretion. Therefore, because some states selected alternative methods for modeling connectivity (e.g., Montana) and many states chose not to make connectivity layers public via the CHAT, this layer is not available for download from the WGA CHAT website. Instead, please direct questions concerning access to and use of this dataset to John Pierce (360.902.2511, dwight.pierce@dfw.wa.gov).

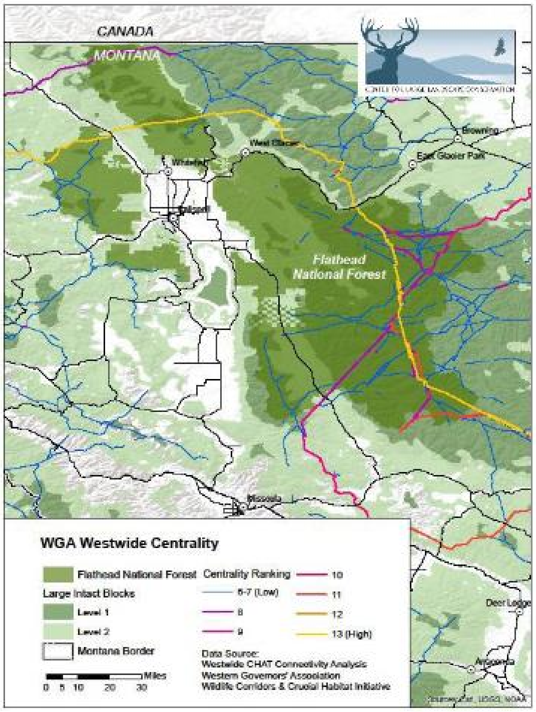

Figure 3. Corridor centrality analysis among Large Intact Blocks, WGA.

B. *Focal species-specific connectivity models*. Several researchers have produced species-specific models of connectivity for forest carnivores that encompass the Flathead region. These models use genetic and/or telemetry data to quantify resistance to movement associated with landscape characteristics, then identify areas offering the least resistance to movement. Providing for movement of these species is commonly thought to serve as an umbrella for movement of other species as well as ecological processes. Therefore, we suggest that these models can serve as important guides for identifying key areas in which to prioritize management for connectivity.

1. Cushman and colleagues (2008) modeled regional conservation corridors for a key forest generalist in the Flathead region, the American black bear. Using a genetically based landscape resistance model and least cost path analysis, they identify major movement corridors for black bears as well as barriers to population connectivity between Yellowstone National Park and the Canadian border (Figure 4). The authors used causal modeling to assign resistance values to landscape features that were most consistent with observed spatial genetic structure, concluding that forested, mid-elevation habitats offer low resistance to movement, while roads present high resistance to movement. The most prominent predicted black bear corridor providing connectivity between Yellowstone National Park and the Canadian border runs directly through the FNF.

2. Schwartz and colleagues (2009) identified wolverine dispersal corridors in the U.S. Northern Rockies based on persistence of spring snow cover (Figure 4). They tested whether a dispersal model in which wolverines prefer to disperse through areas characterized by persistent spring snow cover produced least-cost paths that correlated with genetic distance among individuals, and found that successful dispersal paths are indeed likely to be associated with snow cover, even after accounting for distance effects. Their model suggests that a major artery for wolverine dispersal, connecting wolverine subpopulations in the Bitterroot Mountains and the Greater Yellowstone Ecosystem to more stable populations in Canada, passes directly through the FNF. This wolverine corridor may be central to any climate adaptation strategy for the United States wolverine metapopulation.

3. Squires and colleagues (2013) used telemetry data to model suitable lynx habitat in the U.S. Northern Rockies, then applied least cost path modeling to predict key dispersal corridors. They found that lynx selected mid-elevation habitat with high canopy cover, high vegetation greenness, and low surface roughness. Furthermore, connectivity between lynx habitat in Canada and that in the conterminous U.S. is facilitated by only a few putative corridors that extend south from the international border (Figure 5). The primary putative lynx corridor extending from Canada into U.S. lynx habitat runs directly through the Flathead National Forest. Maintaining the integrity of this corridor is expected to be critical to long-term population recovery of lynx.

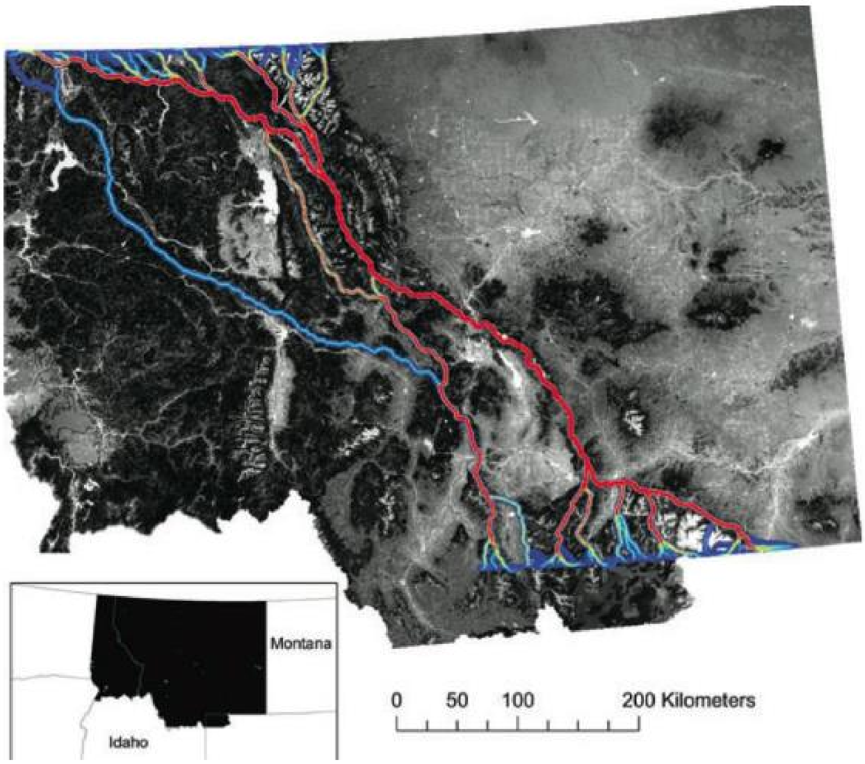

Figure 4. Modeled black bear dispersal corridors, Cushman et al. 2008

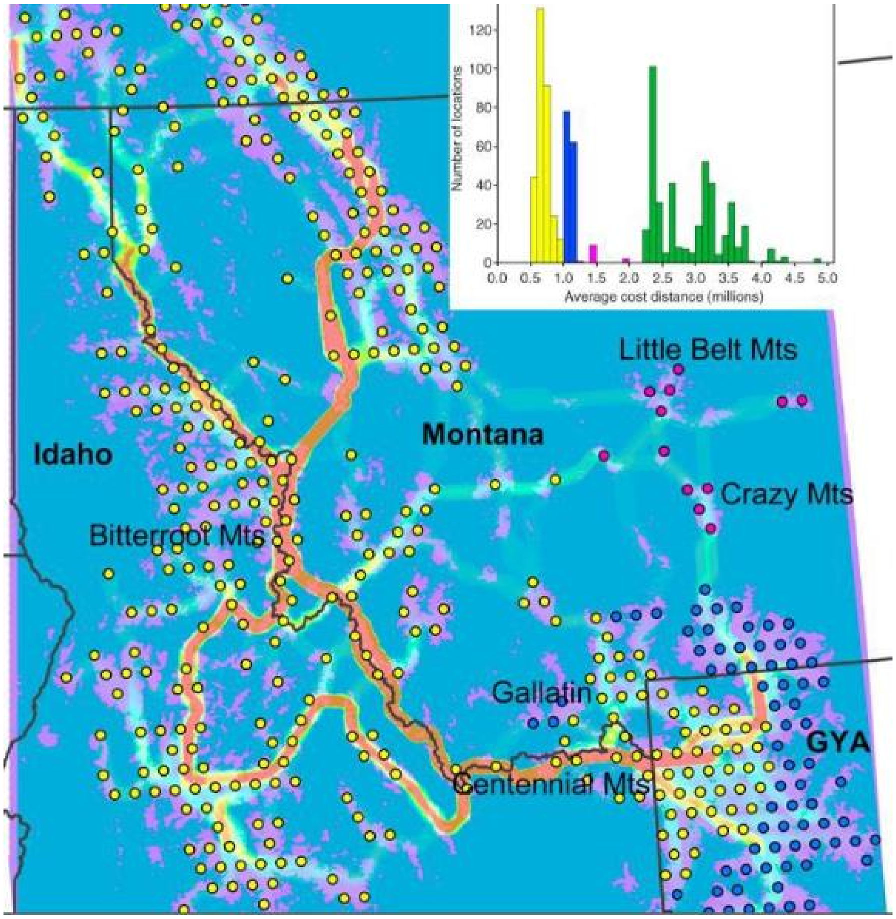

Figure 5. Modeled wolverine dispersal corridors, Schwartz et al. 2009.

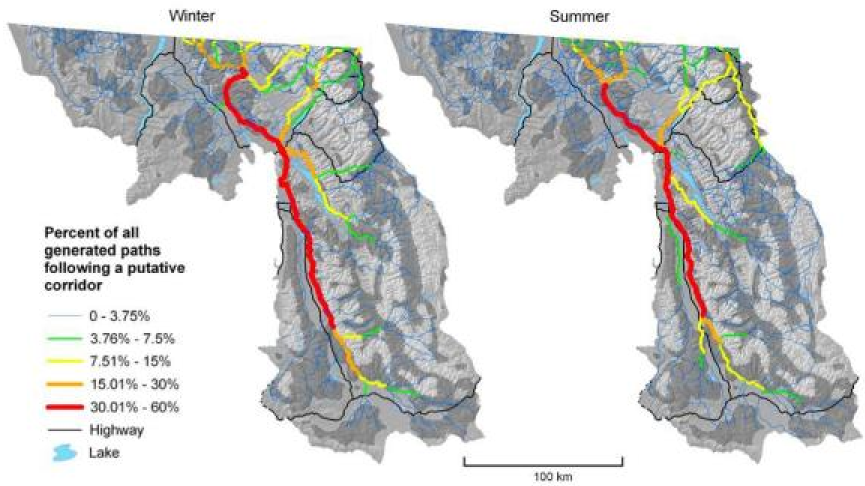

Figure 6. Modeled lynx dispersal corridors, Squires et al. 2013.

4. Proctor and colleagues are expected to soon publish a circuit theory analysis of linkage zones for grizzly bears in the Northern Rockies based on landscape resistance associated with spatial genetic structure and radiotelemetry data (M. Proctor, personal communication). Previous work (Proctor et al. 2012) based on these datasets has indicated that major roads impede grizzly bear movement, especially that of females, resulting in grizzly subpopulations separated by highways in the southern portion of the grizzly bear range, which includes the FNF.

C. *Raw focal species telemetry and genetic data.* The following datasets have been collected by various researchers in and around the FNF, and may help to directly identify key sites supporting focal species movement at fine scales and/or confirm that a focal species does indeed utilize a particular site predicted to be important for movement by the models described above.

1. Lynx tracking data and genetic material has been collected on the Tally Lake and Hungry Horse ranger districts of the FNF during the past two winters (Laura Holmquist, 406-758-3501, lholmquist@fs.fed.us). Lynx tracking and genetic material surveys have also been conducted throughout the Southwest Crown of the Continent, including the Swan Lake District of the FNF, during the past three years, accompanied by camera and video captures (Scott Tomson 406.677.3925, stomson@fs.fed.us and Carly Lewis, 406.329.3848, cwlewis@fs.fed.us); however, these data should be interpreted with some caution as bait stations were employed, which may draw in individuals from some distance away. Additional radiocollar data have been collected for many years on the Seeley Lake (Lolo NF) and Lincoln (Helena NF) ranger districts (John Squires, 406.542.4164, jsquires@fs.fed.us), which may offer insight to lynx habitat selection and space use on the FNF.

2. Tracking, genetic material surveys, and camera and video capture have also been conducted for wolverines throughout the Southwest Crown of the Continent during the past three years, including the Swan Lake District of the FNF (Scott Tomson 406.677.3925, stomson@fs.fed.us and Carly Lewis, 406.329.3848, cwlewis@fs.fed.us). Additional tracking and genetic material has been collected on the Tally Lake and Hungry Horse ranger districts of the FNF during the past two winters (Laura Holmquist, 406-758-3501). Camera documentation of wolverine presence in the Lincoln district of Helena NF is also available (Pat Shanley, 406.362.7006, pshanley@fs.fed.us).

3. Grizzly bear radio telemetry data and genetic data obtained with both invasive and noninvasive techniques have been collected since 1976 in northern Montana, southeast British Columbia, and western Alberta, including parts of the FNF (Michael Proctor, 250.353.7339, mproctor@netidea.com,Chris Servheen, 406.243.4903, grizz@umontana.edu, Kate Kendall, 406.888.7994, kkendall@usgs.gov).

4. Noninvasive genetic sampling of fisher presence has been conducted in northern Idaho and northwest Montana, including much of the FNF (Michael Schwartz, 406.542.4161, mkschwartz@fs.fed.us). We also note that a recent model of changes in the distribution of fisher habitat in this region under alternative climate change scenarios (Olson et al. 2014) suggests a likely increase in fisher habitat in and around the FNF, making connectivity between current stable fisher population centers in central Idaho and likely future habitat in the FNF a potential priority for fisher conservation.

We suggest that the key wildlife corridors identified by the models described above, alongside raw data documenting fine-scale utilization of these areas by species of interest, provide the strongest available basis for setting priorities for connectivity management action in the FNF, and should also serve as focal areas for any further fine-scale scientific study or monitoring efforts. We ask that the FNF Plan Revision Team consider these resources alongside those currently included in the Wildlife Information for Desired Condition Discussion and Appendices E and F, and that these resources be incorporated into the upcoming Plan Revision as the best available scientific information on which to base connectivity management in the FNF.

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Thank you for the opportunity for our organization to provide comments on the FNF's Assessment regarding ecological connectivity, and ultimately for the revision of the Forest Plan. If you have any questions regarding our comments or the information we have provided, please do not hesitate to contact us.

Regards,

Robert Ament
Senior Conservationist

Meredith McClure, PhD
Conservation Biologist

CC: Jim Williams, MDFWP
Paul Sihler, MDFWP Adam
Messer, MDFWP John
Pierce, WDFW

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Commented [rk147]: AP, ACK See FEIS section 3.7.4 fisher

Commented [rk148]: AP, ACK see FEIS section 3.7.5 grizzly bear

Commented [rk149]: CON

Commented [rk150]: AP, PC, ACK see FEIS section 3.7.5 Canada lynx

Letter from Center for Biological Diversity October 3, 2016

Page 18:

Moreover, despite best available science showing that lynx respond negatively to vegetation management projects that remove understory vegetation and forested habitat, the Forest Service plans to implement precommercial thinning projects in lynx habitat to "clarify the relationships between stand treatments and the effects on lynx." DEIS, Vol. 1 at 460. Such "clarification" is not needed and not justified. The best available science is clear that lynx respond negatively to such projects.[32] [32] Squires 2010.

Commented [KR-151]: See FEIS section 3.7.5 and BA discussion of Squires 2010.

Page 19: see response to comments on bull trout, cutthroat trout, INFISH

Letter from Defenders of Wildlife October 3, 2016

The best available science argues against considering the NCDE population of grizzly bears in isolation: "We recommend that the entire regional metapopulation be considered, that multiple jurisdictions work together on a larger strategy to manage the system for inter-area connectivity, particularly of females, and that larger core subpopulations be managed as potential sources of

bears for adjacent smaller threatened subpopulations." (Proctor, et al 2012, p. 39). For the Cabinet-Yaak Ecosystem in particular, the best available scientific information (Kendall, et al 2016, p. 329) demonstrates "the need for comprehensive management designed to support CYE population growth and increased connectivity and gene flow with other populations."

The NCDE CS did recognize the need of other grizzly bear populations for connectivity to the NCDE, and zones 1 and 2 are intended to facilitate connectivity. However, there is no broader conservation strategy that addresses the role of the NCDE in recovery of the species, and the DEIS has provided no scientific justification for the sufficiency of plan components for connectivity in these zones.

Commented [KR-152]: See FEIS section 3.7.5 on grizzly bears, section 6.5 on grizzly bears, response to comments regarding use of Boulanger and Stenhouse to determine sufficiency of plan components in zone 1.

September 29, 2016 letter on behalf of on behalf of the Flathead-Lolo-Bitterroot Citizen Task Force

Page 7: Costello, et al. (2016) state their estimates for sustainable mortality are not appropriate for application without further analysis. Thus, the entire chain of documentation consists of incomplete, draft information subject to further analysis. It does not represent the best available science nor a legal basis for broad changes in land management….The best available science shows that large roadless, wilderness habitats (Type I) are a source habitat for grizzly bears and the roaded matrix with small, dispersed roadless areas (Type II) are a sink habitat (Bader 2000a; 2000c).

Commented [KR-153]: Costello et al (2016, page 3) quotation: "These findings should prove useful for establishing mortality thresholds,
assuming future rates of recruitment and dependent bear survival remain similar to our current estimates.
Continued monitoring of grizzly bear survival rates (cub, yearling, independent female, and independent
male), reproductive parameters (annual proportion of independent females with cubs, mean litter size),
distribution, and mortality will be needed to periodically re-evaluate mortality thresholds and the status and trend of the population". The draft GBCS includes continued monitoring of grizzly bear status and trend.

Commented [KR-154]: See FEIS appendix 8.

The map of the Wildland Urban Interface (WUI) shown in Appendix B, map B-18 provides an inflated definition of WUI far beyond reasonable. The best available science is based on the Structure Protection Zone (SPZ), the area within 100-200 feet from structures (Rheinhardt, et al. 2008).

Commented [KR-155]: See HFRA (Healthy Forest Restoration Act) in glossary. The structure protection zone is considered at the project level.

Citizen reVision of the Flathead Forest Plan March 2014 page 2

"The Citizen reVision is organized with individual sections for each area of conservation concern. Each section contains a condensed summary of the best available science followed by Management Recommendations. A complete bibliography of scientific literature can be found at:http://www.swanview.org/reports/Annotated_Bibliography.pdf."

Commented [KR-156]: See FEIS appendix 8 on Citizen reVision, BASI, A19, INFISH, bull trout, etc.

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Commented [rk172]: CON

Commented [rk173]: DATED, reviewed final revised Kootenai Forest Plan and FEIS

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Commented [rk180]: DATED

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Commented [rk182]: Not cited in the text-don't know context.

Commented [PV183]: PC

Commented [rk184]: IRR

Commented [rk185]: The referenced quote merely acknowledges what we are already implementing.

Commented [rk186]: AP, PC. ACK

Commented [rk187]: This is an opinion piece not science.

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September 29, 2016 letter from Friends of the Wildlife Swan

We are attaching the December 4, 2014 and July 20, 2015 comments of Dr. Christopher Frissell on the bull trout recovery plan because the issues such as habitat metrics, climate change, threats, adaptive management, best available science among others cited are relevant to the Forest Plan revision. A CD containing the scientific literature referenced by Dr. Frissell will be sent to the Forest Plan revision planning team to be included in the project record.

October 13, 2016 letter from Wild Earth Guardians

The only best available science on grizzly bear habitat security and motorized access route density is Amendment 19 to the Flathead Forest Plan (USDA 1995), which was informally adopted by theFlathead and the other NCDE Forests in 2007. USFWS 2007.

Commented [rk264]: AP, PC ACK see numerous Saab citations in FEIS section 3.7.4

Commented [rk265]: ACK, PC see FEIS citations of Saab et al. 2007, Hutto and Gallo 2006, Forristal 2009, Saab and Dudley 1998

Commented [KR-266]: ACK, PC see FEIS citations of Saab et al. 2007, Hutto and Gallo 2006, Forristal 2009, Saab and Dudley 1998

Commented [rk267]: ACK, PC see FEIS section 3.7.5 grizzly bear

Commented [KR-268]: See appendix 8 on bull trout, FEIS citations including Frissell, planning record

Commented [KR-269]: See FEIS appendix 8 on grizzly bear, BASI, A19.

In terms of lynx management, for example, the Flathead relies solely on compliance with the lynx direction which, as discussed herein, is outdated, fails to properly manage (and recruit) lynx winter habitat, and is no longer consistent with the best available science including, but not limited to Kosterman (2014), Squires (2010), the LCAS, and recommendations from the SSA team.

Commented [KR-270]: See FEIS appendix 8 on lynx, connectivity BASI, Kosterman and FEIS section 3.7.5 discussion of LCAS, SSA, 5-year status review, Kosterman, Squires 2010 and Squires 2013.

The best available science on lynx is compiled in the LCAS (2013 update) and is currently being reviewed and studied by the Canada lynx Species Status Assessment ("SSA") team. A report from the SSA team is forthcoming, as is a five-year status review. The LCAS, however, is only rarely mentioned throughout the Draft EIS and Draft Revised Forest Plan and the SSA team's interim reports and findings are not discussed in the documents.

As such, before finalizing the EIS and revised forest plan, the Flathead must carefully review, incorporate and utilize the best available and most up to date science on lynx management, including the LCAS, Squires (2013), Kosterman (2014), and reports from the SSA team.

Commented [KR-271]: See FEIS appendix 8 on lynx, connectivity BASI; BA and FEIS section 3.7.5 discussion of LCAS, SSA, Kosterman, and Squires 2013.

Today, the best available science, including every published peer-review paper on the topic, reveals the wolverine – a snow-dependent species – is threatened by climate change. See Defenders of Wildlife v. Jewell, -- F.Supp.3d – , 2016 WL 1363865 (D. Mont. 2016) (discussing best available science regarding climate change threats); 78 Fed. Reg. 7864 (February 4, 2013) (proposed rule to list wolverine); McKelvey (2011); Copeland (2010). The science also reveals wolverine are threatened by WildEarth Guardians – Flathead LMP and NCDE DEIS Comments – October 3, 2016 an extremely small population size (only 250-300 remain in the contiguous United States) and by the cumulative effects of multiple threats. See id.

Commented [KR-272]: See appendix 8 on wolverine, BA and FEIS section 3.7.5 on wolverine discussion citing McKelvey, Copeland, proposed rule to list the wolverine.

A species of conservation concern is a species other than a federally protected species that is "known to occur in the plan area and for which the regional forester has determined that the bestavailable scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area." 36 C.F.R. § 219.9 (c). With respect to wolverine, the best available science reveals the species is unlikely to persist in the contiguous United States due to loss of habitat (and increased habitat fragmentation) from climate change and an extremely small population size (both actual and effective).

Commented [KR-273]: See appendix 8 on wolverine

According to the best available science, if the meta-population dynamics break down, either due to changes within the subpopulation or due to the loss of connectivity (from climate change or development) then "the entire meta-population may be jeopardized due to subpopulations becoming unable to persist in the face of inbreeding or demographic and environmental stochasticity." 78 Fed. Reg. at 7867.

Commented [KR-274]: PC, See appendix 8 on wolverine, FEIS section 3.7.5 on wolverine

The following recommendations are based on the Forest Service's current roads policy framework and relevant legal requirements, the best available science (summarized in TWS Literature Review) which the Forest Service is required to use under the 2012 Planning Rule, and on examples of plan components from existing forest plans.

Commented [KR-275]: See TWS literature responses above.