Swan View Coalition Nature and Human Nature on the Same Path
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December 19, 2018

Swan Lake Ranger District
Att: Rachel Feigley - Team Leader
200 Ranger Station Road
Bigfork, MT 59911

Re: Scoping Comments on Mid-Swan Landscape Restoration and WUI Project
Submitted as pdf to bslrp@fs.fed.us
With DVD hand-delivered to Swan Lake Ranger District

Dear Ms. Feigley, Ranger Dowling and others;

Please accept these comments in the above matter into the public record. These comments are submitted on behalf of Swan View Coalition, Patty Ames, Lori Andresen/Save Our Blue Waters, Denise Boggs/Conservation Congress, Judi Brawer/WildEarth Guardians, Larry Campbell/Friends of the Bitterroot, Paul Edwards, Michael Garrity/Alliance for the Wild Rockies, Sara Johnson/Native Ecosystems Council, Matthew Koehler/WildWest Institute, George Nickas/Wilderness Watch, and Paul Sieracki. We incorporate by reference the comments being submitted in this matter by Friends of the Wild Swan, including any information FOWS incorporates by enclosure of reference.

These comments will be organized into three parts. The main letter contains comments on the proposal based on our experience with the current Flathead Forest Plan, the pending revised Forest Plan, numerous projects proposed by the Flathead to be implemented under these Plans, and our on-the-ground knowledge. Appendix 1 is comments prepared by WildEarth Guardians, largely regarding road management and travel planning relevant to this Project. Appendix 2 is comments and questions prepared by Alliance for the Wild Rockies and Native Ecosystems Council to guide your preparation of the EIS. All three of these parts, however, are submitted on behalf of all of the parties listed above. (Please note that Attachment A is referenced in Appendix 1, but appears after Appendix 2 along with Attachments B and C).

We also include with this letter a DVD of pertinent documents that we ask you to review and include in the Mid-Swan project records. These documents go to the heart of the issues we raise in this letter about the assessment and management of roads, culverts, trails, motorized vehicles, non-motorized human recreation, and their impacts to water quality, fish and wildlife.

Purpose and Need and EIS Alternatives

The Scoping Document (SD) attempts to paint this Project as “landscape restoration” while largely ignoring the already excessive road system. The SD includes lots of information on what the historic vegetative conditions may have been - and proposes substantial amounts of logging and other manipulations to allegedly restore those conditions.

There is not a single word, however, of how many roads existed historically. Historically, there we no roads in the Project Area - so to what degree should this area be restored to its historic, natural conditions in terms of roads? This needs to be a part of the Purpose and Need and displayed in a broad range of NEPA alternatives and the assessment of the effects of those alternatives.

Part of the Purpose and Need must also be to arrive at a “minimum road system” that is truly sustainable both environmentally and fiscally. (See Appendix 1). There are already 1,240 miles of roads in the Project Area, with 570 of those miles a part of the National Forest road system - and the Project proposes to build at least 60 more miles. (SD at 5 and 21). How best to arrive at a sustainable minimum road system must be a part of the Purpose and Need and displayed in a broad range of NEPA alternatives and the assessment of the effects of those alternatives.

Upgrading/stormproofing some 167 miles of existing Forest Service roads, while constructing 60 miles of new roads and an undetermined mileage of temporary roads (SD at 5 and 21), will not arrive at a sustainable minimum road system. Nor will it adequately “restore and maintain aquatic [and] terrestrial biodiversity in light of climate change,” as claimed in the Purpose and Need (SD at 4).

Stormproofing does not require the removal of all stream-aligned culverts in order to insure they do not plug and otherwise fail in locations where they are not routinely monitored and maintained. Moreover, “[a]ll of the roads proposed for stormproofing are currently closed to public motorized access and many are currently un-drivable due to vegetation growth” (SD at 5).

This suggests that the roads being stormproofed are perhaps those contributing the least sediment to waterways and calls into question whether the vegetation will be stripped from those roads in order to remove or upgrade culverts, stabilize slumps, etc. (or will some of these roads simply be deemed “stormproofed” with no on-the-ground work done to them)? It also calls into question what roads in addition to those already closed to motor vehicles should be closed, if not reclaimed and decommissioned? Where is an assessment of all culverts, slumps and other sediment-conducive features on all the roads in the Project Area, including those identified for stormproofing?

“One design criteria for this project is that no change in public motorized use would occur” (SD at 22). Where is the analysis indicating that aquatic and terrestrial biodiversity can be restored and maintained with the current level of motorized access? This front-loaded conclusion is arbitrary, capricious and skews the entire analysis with a political premise. This premise is not based in the best available science, which robustly documents the adverse effects of forest roads, especially those open to motor vehicles, on aquatic and terrestrial species. (See Appendix 1 and Attachment A).

Is there, for example, a positive correlation between open roads and the 32 beaver dams known to be "inactive?" (SD at 6). Where are these beaver dams located and why no beavers? Former District Fisheries Biologist Mike Enk called for road closures in the Swan Valley because people were shooting bull trout with guns from bridges and other key stream crossings. Could there be a similar correlation with the absence of beaver? Why does the Project not call for the restoration of beaver and beaver security rather than the building of nine "beaver analog structures?" (SD at 13). The former constitutes restoration of aquatic biodiversity, while the latter does not.

The SD lacks information essential to determining to what degree open road densities and total road densities must be reduced in order to restore and maintain aquatic and terrestrial biodiversity in light of climate change. It references no standards that will be applied to road management, let alone whether the standards that may be applied will come from the current Forest Plan or the revised Forest Plan.

Lack of a Clear NEPA and NFMA Foundation

The SD states in a footnote on page 5 that it has not been determined which Forest Plan the Project will be assessed under and must comply with. This makes it almost impossible for the public to comment meaningfully on the Project, raise appropriate issues about the Project, and describe how it must be modified to comply with the Forest Plan. Instead, this lack of a clear National Environmental Policy Act and National Forest Management Act foundation and process leaves us with a lot of questions. Here are just a few:

1. Will the Project comply with the current Forest Plan Amendment 19's standards for Open Road Density, Total Road Density, and Security Core (also known as OMRD/TMRD/Security Core and 19/19/68)?

We use TRD and TMRD interchangeably here, as do the Glacier Loon and Beaver Creek EAs and DNs found in DVD Folders 32 and 02, respectively. We explain in detail in our Roads to Ruin report and its supplements (DVD Folder 04) how Total Motorized Route Density evolved from Total Road Density in order to included motorized trails, not to exclude roads that simply block motor vehicles but still exist as roads/trails that allow other human uses.

2. What are the existing values for these A19 parameters in the Project Area's grizzly bear subunits? How many and which roads need to be closed or reclaimed/ decommissioned to meet the 19/19/68 standards?

3. How would the Project comply with and be assessed under the revised Forest Plan in terms of the above parameters - and how will these parameters be tracked and measured against what FWS calls the 19/19/68 "research benchmarks" indicating threshold levels of "take" of grizzly bears?

4. Will the Project require that a road be "decommissioned"/removed from the road system and no longer function as a road or even a non-motorized trail in order to lower TRD/TMRD, as in the current Plan? Or will it follow the revised Plan and simply require that the road be blocked and off-limits to motorized uses during the grizzly bear non-denning season?

5. Will the Project require that temporary roads be thoroughly reclaimed/ decommissioned and no longer function as a road or trail, or will it follow suit with the Crystal Cedar Project and allow mountain bike and other trails on temporary roads, as presumably allowed under the revised Plan? (See the Crystal Cedar scoping documents at https://www.fs.usda.gov/project/?project=52844).

6. Will the Project require that high-use non-motorized trails disqualify nearby areas from being considered grizzly bear Security Core, acknowledging that non-motorized human uses displace bears and can have population level impacts on bears (as in the current Forest Plan)? Or will the Project dismiss those human impacts and not buffer high-use trails out of what the revised Plan now calls "Secure Core?" The latter allows unlimited miles of high-use non-motorized trails to exist without ever reducing Security Core/Secure Core, in violation of the best available science!

In this regard, please read the grizzly bear research papers we have included in Folder 24 of the enclosed DVD. We hope you have already read Mace and Manley (1993), the South Fork Grizzly Bear Study Progress Report finding that bears continue to be displaced from closed roads until those roads have re-vegetated to the point that foot travel is essentially impossible. We also hope you have already read the Final Report in that study (Mace and Waller, 1997) showing in Section 7.2 that grizzly bears were significantly displace by non-motorized human activities like hiking and camping. The latter report also cites the paper we have included on the DVD as "Kasworm Manley 1990 roads and trails.pdf," wherein researchers find grizzly bears are displaced from trails, including roads closed to motor vehicles but still functioning as trails.

A couple newer papers in Folder 24 that we ask you to read are:

"Fortin et al 2016.pdf," wherein researchers find that grizzly bears are displaced by non-motorized human activities and that "increased energetic costs associated with displacement may be a primary mechanism by which recreation affects bear health with consequent population-level effects."

"Ladle_et_al-2018-Journal_of_Applied_Ecology.pdf," wherein researchers find that female grizzly bears with cubs "avoided trails, irrespective of associated motorized activity."

7. Will the Project be assessed and abide by A19 definitions that cap the total miles of road allowed in the Flathead's road system by requiring that roads be reclaimed/decommissioned and removed from the road system in order to lower TRD/TMRD and insure there is no net increase in TRD/TMRD? Or will the Project cheat those definitions as the Flathead has done since 2011 or 2013, allowing reclaimed roads to remain in the system as roads but not count them in TRD/TMRD - which allows an infinite number of roads to exist in bear habitat?

8. Why propose a Project, such as this one, that requires the suspension of two lynx management standards to implement - regardless of which Plan it is planned and implemented under (SD at 9 and 21)? If the Flathead is so convinced that lynx research indicates it should deviate from the Northern Rockies Lynx Management Direction, it should secure changes in that Direction, not write that direction into its revised Forest Plan and then immediately attempt to excuse itself from it via project-specific suspensions and amendments. This is looking already like a replay of the "Cottonwood" lawsuit and court decision.

Scoping Period is Untimely and Inadequate, as is the EIS Timeline

Why was this SD and 30-day public comment period issued before the revised Forest Plan was signed, leaving it unclear which Plan the Project would be analyzed under? When most of the signors on this letter, among others, asked for a 60-day extension to review the 51-page SD and its 17 maps, why was the comment period extended only 30 days and set to close the day before Christmas instead of well after the holidays?

While we appreciate the extra 30 days to provide comment, it is still inadequate, especially in light of the Forest Plan limbo described above. We have requested hard copies of the revised Forest Plan and FEIS but have yet to receive them and the revised Plan has not yet been decided/signed. We have looked for the Mid-Swan "assessment(s)" referenced repeatedly in the SD, but cannot find it/them online anywhere, let alone on the Mid-Swan "project page" of the Flathead's web site. With a project of this scale, an assessment needs to be issued along with the scoping notice - much as an Assessment of a particular National Forest is supposed to be issued during scoping for a Forest Plan revision.

What we do find on the Mid-Swan "project page" is the Scoping Presentation given at the November 8 Mid-Swan scoping meeting. On page 43 it states that this 70,000 treatment acres Project is equivalent to 35 standard NEPA documents! Why then are you trying to squeeze this Project into a compressed NEPA timeframe?

Moreover, the Flathead's SD and press release for Mid-Swan Project scoping essentially imply that the Southwest Crown Collaborative (SWCC) helped develop this Project proposal. When we raised concerns about the SWCC helping propose 60 miles of new road construction in the name of "landscape restoration," however, Luke Lamar of Swan Valley Connections responded:

> Keith, thanks for sharing your thoughts with the group. As a point of clarification, the SWCC provided constructive criticism and feedback to the Mid-Swan team as *they* developed this proposal. The topic of new, permanent roads was never discussed between the SWCC and the Mid-Swan team at any of our meetings. Unfortunately, Chip Weber used some very poorly chosen words when he described the SWCC's involvement as "crafting/developing" this proposal in recent print media. Many members of the collaborative were just as surprised as you about the new, permanent road additions in the proposal and is just one of many topics the SWCC will address in our comments.

(Emphasis in original. See Attachment B for this email exchange made on the public SWCC listserve.)

Moreover, the Collaborative Forest Landscape Restoration Act (otherwise known as CFLRP) prohibits use of its funding for the building of new roads. So is this a CFLRP project, or not? Or does the Flathead use CFLRP funds to help fund collaboration but then use other funds to build 60 miles of new roads and other things the collaborative and CFLRP does not support? The Landscape Restoration Act itself supports our contention that building of new roads cannot be considered to be landscape restoration.

As we responded to Mr. Lamar, we are concerned that many people likely think the SWCC indeed supports this project and are likely to submit scoping comments supportive of the Project because they either trust the judgment of this particular collaborative group or like the idea of proposals being developed collaboratively. To date, neither the Flathead nor the SWCC has issued any broad public clarifications about the limits to SWCC's involvement in crafting this proposed Project.

We ask that the Flathead reinitiate scoping for this Project until after it: a) is certain which Forest Plan this Project will be assessed under and must comply with, b) has insured the public has had ample time to review that Plan and understand it, c) has posted all relevant assessments and other planning documents on its web site, and d) has issued a press release clarifying to what degree the SWCC has and has not been involved in the development of this Project.

The Flathead is rushing this scoping process and proposes a similarly rushed timeline for preparation of an EIS (SD at 23). Proposing to issue a DEIS only four months after the scoping comment period ends leaves the public to wonder whether scoping comments will be seriously considered. The timeline for having an FEIS completed by October 2019 is similarly rushed. The Nov. 8 Scoping Presentation, at 9, states the Project will "Move fieldwork to after decision," leaving the public to wonder if the Forest Service even knows the details of what it is talking about and proposing.

This is a huge Project and a huge chunk of landscape. As noted above, it is the equivalent of 35 NEPA documents. If the SD is 51 pages and includes 17 maps that we are struggling to comprehend on short notice, please take that as a clue that you need to relax the timeline for your EIS process so that your ID Team and the public can be sure they understand the implications of this Project.

What exactly is the "life of the Record of Decision for this project" (SD at 21). The SD doesn't say but the press is reporting it is 30 years or more. The brevity of the scoping and EIS process you outline is not commensurate with the spatial and temporal size of this Project.

Examples of the Need for a Precise Road and Culvert Inventory

It is disingenuous for the SR, on page 21, to mention the 60 miles of new road construction as simply a "connected action." It is also disingenuous to utilize definitions of "motorized route access" and "secure core" that imply this increase in road miles will not have adverse impacts to grizzly bears and other fish and wildlife.

As mention above, the Flathead changed up these definitions beginning in 2011-2013 under its current Forest Plan and in anticipation of its revised Forest Plan in order to allow an infinite mileage of roads and trails to exist on the Forest without increasing TRD/TMRD or decreasing Security Core/Secure Core. For more details, please see the enclosed DVD and read our Forest Plan Objection in Folder 00 and our Roads to Ruin Report and its Supplements in Folder 04. Simply put, rendering a road "impassable" to motor vehicles does not excuse it from calculations of TRD/TMRD. Similarly, high-level non-motorized use of roads and trails cannot be excused from disqualifying nearby Security Core.

The Flathead itself seems to be confused about its definitions, having designated a number of roads "impassable" to motor vehicles and/or "stormproofed" and removing them from calculations of TRD/TMRD. When Swan View Coalition, Friends of the Wild Swan and WildEarth Guardians threatened to sue the Flathead over one of those roads in 2016 (Raghorn #10802) the Flathead agreed to remove all of the culverts from that road. This was finally accomplished in 2018 under a contract awarded in 2017. (See DVD Folder 12).

As a result, the Flathead also undertook a survey of other impassable/stormproofed roads in 2017. It corrected its initial survey data spreadsheet in 2018 and provided it to Swan View Coalition. Please see DVD Folder 20 for this data and the photos (Subfolder FOIAphotos_2017) of the many stream-aligned culverts, failed/failing culverts, landslides, and slumps left in these impassable and/or stormproofed roads. In summary, 17 of the 77 roads surveyed had stream-aligned culverts left in place (Subfolder 180829 Correction; Keith Corrected Digest INTMRD.pdf - also attached as Attachment C for convenience).

Omitting these roads from TRD/TMRD is in clear violation of the current A19 because not all stream-aligned culverts were removed. Under the revised Plan, culverts can remain in place and the road omitted from TRD/TMRD simply because it is rendered impassable to motor vehicles. Again, take a look at the photos in Folder 20; Subfolder FOIAphotos_2017 to see what agency discretion looks like in terms of what condition roads can be left in as impassable, Intermittent Stored Service, stormproofed, etc.. A glimpse can also be gleaned from the descriptions contained in Attachment C to this letter.

The Flathead in 2017 also inspected 46 stream-aligned culverts in bull trout watersheds on 14 Maintenance Level 1 closed roads it <u>does</u> count in TRD/TMRD. Of these 46 culverts, 27 (59%) had inlets that were blocked, had a rust line of >35% of the inlet height indicating the culvert is undersized to handle extreme flows, had ponding or overflow indicating the culvert is undersized or incorrectly positioned, or had a crushed inlet. (See DVD Folder 26; Hammer Summary of 2017 BT Culvert Survey.pdf).

The Flathead also seems confused about its roads in the Project area. It took years of effort by the District Fisheries Biologist Beth Gardner, but the Flathead finally removed most of the stream-aligned culverts from North Lost Road #5206, including two in

Spring Slide Mountain's south-facing avalanche chutes that had repeatedly plugged with avalanche debris.

Inexplicably, however, it left at least two stream-aligned culverts in place - including a 72" x 45" "squash pipe" at Spring Slide Creek. The Flathead had determined this culvert in 2002 to be a fish barrier and later reported it as "pulled prior to 2010." Beth Gardner, however, confirmed this culvert was still in place on August 25, 2010. We confirmed it is indeed still there by doing a photo survey of Road #5206 on 6/4/16!

The Project, as indicated on Map 1, proposes to treat the entirety of Road #5206 as "Improve Forest Service Road Best Management Practice." Why would this be applied to the portion of the road that has had stream-aligned culverts removed and why is the fish-barrier culvert at Spring Slide Creek not among those slated for removal?

Another road in the Project area, Goat Creek Road #10503 finally had its stream-aligned culverts removed last summer, including a large culvert plugged for years with avalanche debris. So why does the Project now propose another spur be built from Road #10503 and why are other new roads proposed to cross higher elevation avalanche chutes in Goat Creek, near Napa Point? This Project, rather than landscape restoration, appears to be the continuation of a process of taking two steps backward for every step forward.

Moreover, the new roads proposed near Napa Point are in a large de-facto roadless area that is contiguous with the Inventoried Roadless Area along the Swan Crest. This area should be preserved as a roadless area and brought into the IRA inventory to gain the protections afforded in the Roadless Rule. The roads proposed at both upper and lower elevations in Goat Creek will make Forest Service lands look like the former Plum Creek lands (now State lands) between Goat and Squeezer Creeks - and that's not something to be proud of.

We are talking about critical bull trout habitat in Goat Creek, by the way. Stormproofing a few already-closed and likely already re-vegetated roads in Goat Creek, after rebuilding them to access new road construction (see Map 1), will hardly result in a net gain for water quality and aquatics and cannot be considered a restoration of aquatic biodiversity!

The upshot here is that the public has good reason to question the Flathead's management of roads and culverts. The Project analysis must include a very thorough inventory of each road, each culvert in those roads, the degree of re-vegetation of those roads, and what exactly will be done to those roads to insure culverts can't plug up and roads won't contribute sediment to streams.

Leaving road treatments and culvert risk assessments up to the discretion of the Forest Service under vague definitions of impassable, ISS, reclaimed, etc. will not be adequate. Again, please review the photos (in DVD Folder 20; Subfolder FOIAphotos_2017) of the many stream-aligned culverts, failed/failing culverts, landslides, and slumps left in impassable and/or stormproofed roads at the discretion of the Flathead NF. A spreadsheet summary of these problem roads is also attached as Attachment C for convenience.

This Project cannot be called "restoration" when it is simply a matter of perhaps lowering risks to water quality. It needs to be a matter of eliminating risks to water quality and improving water quality in order to qualify as restoration.

Vegetation

The vast majority of the SD talks about vegetation and essentially asks the public to trust that the agency and industry that chopped up the forest at lower elevation via logging and road building can somehow stitch it back together again via logging and road building. And, when it reports that forest patch size at higher elevations is too big due to fire suppression, the SD essentially again asks the public to trust that this can be rectified through logging and thinning that requires extensive road building (for example, near Napa Point and Scout Creek in the Goat Creek watershed).

A number of scientists and researchers are skeptical of the approach being taken in this Project. Whether conducted in the WUI or in the backcountry, logging and thinning has been found to be largely ineffective at changing fire behavior because it can't accurately predict where fire will occur and pales in the face of extreme whether and fire events. Please see DVD Folder 33 for Dr. Dominick DellaSala's 9/27/17 testimony in these matters for a good overview of the relevant research. We also include in Folder 33 Six et al (2018), which finds that logging and thinning likely screws up the natural selection process by removing trees that are the most genetically adapted to pine beetles - a choice that only nature can best make - and hence adds the thinning mortality to the natural mortality.

We have similar concerns about prescribing fire in Wilderness areas and the proposal to sow white bark pines seeds in the Mission Mountains Wilderness. This violates the basic premise of wilderness as a self-willed landscape. Howard Zahniser, the author of the Wilderness Act, put it best in 1963 when he penned an editorial whose title was Guardians Not Gardeners. Rather, this action strikes at the very heart of wilderness as untrammeled or self-willed. The agencies do not have the authority to purposely trammel wilderness by this kind of alternation of natural processes.

Further, nature is slowly healing the destruction wrought by humans through natural selection of resistant trees and seedlings. This natural process will provide the most durable and effective resistance to one of the pests (rust). In host-pathogen interactions, when a virulent pathogen first meets its host, it usually kills it quickly. However, this is neither advantageous to the host nor the pathogen. Thus, the relationship evolves over time, and eventually the pathogen does less and less damage to the host, until eventually the relationship may become mutualistic or symbiotic. Meddling in this natural process by artificially increasing the numbers of some resistant genotypes, is likely to select for virulence in the pathogen and extend the process, or even short circuit it.

The related white pine issue provides an interesting lesson. With the resistant white pine breeding program, ratios of resistant to susceptible F2 progeny are very close to the 3:1 ratio expected with a single dominant resistance gene (Fins et al. 2001). The ability of pathogens to quickly mutate at avirulence loci to overcome resistance genes is well documented in many plant-pathogen interactions. In plants that are re-planted each year, this problem can be managed by monitoring the pathogen genotypes in the field, and then selecting host genotypes for the next year which are resistant to the current pathogen genotypes. Obviously, this is not possible with trees. Apparently, mutation to overcome white pine blister rust resistance has already occurred in California and Oregon (Fins et al. 2001). It is likely that this has also already occurred in Idaho locations where up to two thirds of the genetically resistant trees have been killed by rust (Fins et al. 2001). As such, planting white bark pines in Wilderness may make the problem worse.

Summary

In summary, the Forest Service displays hubris in this Project proposal. It gives short shrift to the idea that nature can heal itself if the impediments to that healing are removed. It instead proposes to correct the problems created by human intervention through what research is already showing may be equally misguided human intervention.

The Project proposes to fix problems created by logging and road building with more logging and road building. It purports to do this while citing the Interior Columbia River Basin Ecosystem Management Project, which to the contrary and along with numerous other studies, found that roaded and managed ecosystems were the least resilient while those that were unroaded and unmanaged were the most resilient. High road densities have been correlated with nearly every malady that compromises ecosystem integrity. (See the Annotated Bibliography attached to Friends of the Wild Swan's comments and the 3/28/16 version of that bibliography included in DVD Folder 34).

The largest impediment to ecosystem resilience in the Mid-Swan area is the excessive road system, which greatly increases the likelihood of human-caused fires and the spread of noxious weeds. In order to restore the Mid-Swan landscape and help protect the WUI, this Project must focus its active management on reducing the extensive road network instead of reducing vegetation far outside the immediate vicinity of homes and structures.

Sincerely,

Keith

Keith J. Hammer
Chair

Also signing for: (see next page)

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APPENDIX 1: Written by WildEarth Guardians

Identifying a resilient future road system that is economically and environmentally sustainable is one of the most important endeavors the Forest Service can undertake to restore aquatic systems and wildlife habitat, facilitate adaptation to climate change, ensure reliable recreational access, and operate within budgetary constraints. And it is a win-win-win approach: (1) it's a win for the Forest Service's budget, closing the gap between large maintenance needs and inadequate (and declining) funding through congressional appropriations; (2) it's a win for wildlife and natural resources because it reduces negative impacts from the forest road system; and (3) it's a win for the public because removing unneeded roads from the landscape allows the agency to focus its limited resources on the roads we all use, *improving* public access across the forest and helping ensure roads withstand strong storms.[1]

1. **Provide support for the claimed needs, and clearly articulate the statement of purpose and need to address the agency's duty to identify the minimum road system.**

We urge the Forest Service to revise its statement of purpose and need to include the need to identify a minimum road system. Applicable statutory and regulatory requirements should shape a project's statement of purpose and need. When the agency takes an action "pursuant to a specific statute, the statutory objectives of the project serve as a guide by which to determine the reasonableness of objectives outlined in an EIS." *Westlands Water Dist. v. U.S. Dept. of Interior,* 376 F.3d 853, 866 (9th Cir. 2004). Under subpart A of its travel rule, the Forest Service has a substantive duty to address its over-sized road system. *See* 36 C.F.R. § 212.5. This underlying substantive duty must inform the scope of, and be included in, the agency's NEPA analysis. After more than 15 years since finalizing the subpart A rules, the Forest Service can no longer delay in addressing this duty.

2. **Consider direct, indirect, and cumulative impacts.**

Impacts from Forest Roads

The best available science shows that roads cause significant adverse impacts to National Forest resources. *See, e.g.*, 66 Fed. Reg. at 3208 ("Scientific evidence compiled to date [2001] suggests that roads are a significant source of erosion and sedimentation and are, in part, responsible for a decline in the quality of fish and wildlife habitat."). A 2014 literature review from The Wilderness Society surveys the extensive and best available scientific literature—including the Forest Service's General Technical Report synthesizing the scientific information on forest roads (Gucinski 2001)—on a wide range of road-related impacts to ecosystem processes and integrity on National Forest lands.[2] Erosion, compaction, and other alterations in forest geomorphology and hydrology associated with roads seriously impair water quality and aquatic species viability. Roads disturb and fragment wildlife habitat, altering species distribution, interfering with critical life functions such as feeding, breeding, and nesting, and resulting in loss of biodiversity. Roads facilitate increased human intrusion into sensitive areas, resulting in poaching of rare plants and animals, human-ignited wildfires,

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[1] *See* 66 Fed. Reg. 3206, 3208 (Jan. 12, 2001) (Administration of the Forest Development Transportation System; Prohibitions; Use of Motor Vehicles Off Forest Service Roads) ("The final road management policy will improve access by allowing the agency to focus its limited resources on the roads people need and use.").

[2] *See* The Wilderness Society, *Transportation Infrastructure and Access on National Forests and Grasslands: A Literature Review* (May 2014) (Attachment A).

introduction of exotic species, and damage to archaeological resources. Here, the Forest Service should also consider how the proposed action may further exacerbate cumulative impacts to the watershed resulting from the existence and use of both system and non-system roads in the project area.

Roads, Trails, and Invasive Species

Roads contribute to the spread of invasive species and noxious weeds. Roads themselves, regardless of whether they are open to public or closed, split apart the forest landscape, creating more buffers where invasive species are likely to grow. Attachment A at 11. The Forest Service should include in its analysis an assessment of how the roads in the project area themselves (even absent vehicles and regardless of maintenance level) provide a vector for the spread of invasive species by fragmenting the landscape and creating buffers that are less resistant and resilient to stressors like invasive species and noxious weeds.

Forest Roads and Fire

Science shows that roads and trails play a role in affecting wildfire occurrence. *See* Attachment A at 9 (noting human-ignited wildfires account for more than 90% of fires on national lands and are almost five times more likely in areas with roads). What's more, closed roads that remain on the landscape can affect where and how forests burn. *Id.* Because closed roads remain on the landscape and thus continue to allow for human caused wildfires, this further supports the proposal to decommission at least some of the roads in the project area following vegetation management activities.

Climate Change & Logging

Logging the forest will not resolve an increasing fire activity period that is being governed mainly by climate change. Thinning in dry forests has limitations, and it will not solve the increase in fire activity. The Forest Service must address how climate change is contributing, and is likely to contribute to, the forest conditions in the project area.

Thinning is not carbon neutral. *See, e.g.*, J.L. Campbell, *et al.*, Can fuel-reduction treatments really increase forest carbon storage in the western US by reducing future fire emissions? Front Ecol Environ (2011), DOI 10.1890/110057 (revealing high carbon losses associated with fuel treatment, as compared to only modest differences in the combustive losses associated with high-severity fire and low-severity fire that fuel treatment is meant to encourage). The Forest Service must consider how the proposed actions may reduce the extent to which the forest in the project area is able to act as a carbon sink. Young forests store much lower amounts of carbon compared to mature and old-growth forests. And with increasing fire activity and increasing effects from our changing climate, the Forest Service must consider the cumulative impacts of logging on each of these.

Climate Change & Forest Roads

Climate change is a major challenge for natural resource managers because of the magnitude of potential effects and the related uncertainty of those effects. A robust analysis under NEPA of the forest road system and its environmental and social impacts is especially critical in the context of climate change.

Climate change intensifies the impacts associated with roads. For example, as the warming climate alters species distribution and forces wildlife migration, landscape connectivity becomes even more critical to species survival and ecosystem resilience.[3] Climate change is also expected to lead to more extreme weather events, resulting in increased flood severity, more frequent landslides, altered hydrographs, and changes in erosion and sedimentation rates and delivery processes.[4] Many National Forest roads are poorly located and designed to be temporarily on the landscape, making them particularly vulnerable to these climate alterations.[5] Even those designed for storms and water flows typical of past decades may fail under future weather scenarios, further exacerbating adverse ecological impacts, public safety concerns, and maintenance needs.[6] At bottom, climate change predictions affect all aspects of road management, including planning and prioritization, operations and maintenance, and design.

The Forest Service has a substantive duty under its own Forest Service Manual to establish resilient ecosystems in the face of climate change.[7] More broadly, the Forest Service has a mission to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. The agency's own climate change science identified above demonstrates how climate change places ecosystems on our national forests at risk. Thus to fulfill its mission, the Forest Service must address the risks of climate change when managing activities involving roadwork on our national forests.[8]

Here, the Forest Service must analyze in detail the impact of climate change on forest roads and forest resources. It should start with a vulnerability assessment, to determine the project area's exposure and sensitive to climate change, as well as its adaptive capacity.[9] For example, the agency should consider the risk of increased disturbance due to climate change when analyzing this proposed project. It should include existing and reasonably foreseeable climate change impacts as part of the affected environment, assess them as part of the agency's hard look at impacts, and integrate them into each of the alternatives, including the no action alternative. The agency should also consider the cumulative impacts likely to result from the proposed project, proposed road activities, and climate change.[10] In planning for climate change impacts and the proposed road activities, the Forest Service should consider: (1) protecting large, intact, natural landscapes and

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[3] Attachment A at 9-14.

[4] *See, e.g.*, Halofsky, J.E. et al. eds., USDA, Forest Service, Pacific Northwest Research Station, *Adapting to Climate Change at Olympic National Forest and Olympic National Park*, PNW-GTR-844 (2011), pages 21-27.

[5] *See, e.g.*, *id.* at 36-38.

[6] *See, e.g.*, Strauch, R.L. et al., *Adapting transportation to climate change on federal lands in Washington State*, Climate Change 130(2), 185-199 (2015) (noting the biggest impacts to roads and trails are expected from temperature-induced changes in hydrologic regimes that enhance autumn flooding and reduce spring snowpack).

[7] *See, e.g.*, FSM 2020.2(2) (directing forests to "[r]estore and maintain resilient ecosystems that will have greater capacity to withstand stressors and recover from disturbances, especially those under changing and uncertain environmental conditions and extreme weather events"); FSM 2020.3(4) ("[E]cological restoration should be integrated into resource management programs and projects . . . Primary elements of an integrated approach are identification and elimination or reduction of stressors that degrade or impair ecological integrity.").

[8] USDA, Forest Service, *National Roadmap for Responding to Climate Change* at 26 (2011), *available at* http://www.fs.fed.us/climatechange/pdf/Roadmapfinal.pdf, page 4 (outlining the agency's plans to respond to climate change through assessing risks and vulnerabilities, engaging to seek solutions, and managing for resilience).

[9] Halofsky at 36 ("potential climate change effects underscore the need to increase activity and be proactive in priority areas to avoid impacts associated with infrastructure failure.").

[10] *Id.* ("Managers will likely need to evaluate the density, location, design, and maintenance intensity of roads and related structures in the context of climate change to avoid escalating road maintenance costs associated with [climate change] impacts").

ecological processes; (2) identifying and protecting climate refugia that will provide for climate adaptation; and (3) maintaining and establishing ecological connectivity.[11]

3. Consider and apply the forest-wide travel analysis report and identify the minimum road system.

The Forest Service faces many challenges with its vastly oversized, under-maintained, and unaffordable road system. What's more, the impacts from roads to water, fish, wildlife, and ecosystems are tremendous and well documented in scientific literature. To address its unsustainable and deteriorating road system, the Forest Service promulgated the Roads Rule (referred to as "subpart A") in 2001. 66 Fed. Reg. 3206 (Jan. 12, 2001); 36 C.F.R. part 212, subpart A. The Roads Rule created two important obligations for the agency:

(1) Identify the minimum road system needed for safe and efficient travel and for the protection, management, and use of National Forest system lands; and
(2) Identify unneeded roads to prioritize for decommissioning or to be considered for other uses.

36 C.F.R. § 212.5(b).

Now that the forests have completed travel analysis reports, the next step under subpart A is to consider the legally valid portions of the relevant travel analysis report and begin to identify and implement the minimum road system.[12] National guidance directs this to happen through analysis of site-specific projects of the appropriate geographic size under NEPA.[13] Given the Forest Service is considering changes to and maintenance of a large number of road miles under this proposal, and given its large geographic scale, this is precisely the type of project where the Forest Service should consider its travel analysis report and begin to identify and implement the minimum road system.

Moving towards an economically sustainable road system on the forest is not a new concept.[14] The Forest Service should take this opportunity to assess the fiscal sustainability of the project area's road system. It should propose additional changes to the road system to bring it closer to the realistic future funding estimates.

In deciding which roads to keep on the system and maintain, versus which roads to close or decommission, the Forest Service must consider the factors that make up a minimum road system as defined by its own regulations. The rules define the minimum road system as that needed to:

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[11] *See* Schmitz, O.J. and A.M. Trainor, *Adaptation Approaches for Conserving Ecosystem Services and Biodiversity in Dynamic Landscapes Caused by Climate Change*, USDA Forest Service RMRS-P-71 (2014), pages 301-303.
[12] *See* Memorandum from Leslie Weldon to Regional Foresters *et al.* on Travel Management, Implementation of 36 CFR, Part 212, Subpart A (Mar. 29, 2012), page 2 ("The next step in identification of the [minimum road system] is to use the travel analysis report to develop proposed actions to identify the [minimum road system] . . . at the scale of a 6th code subwatershed or larger.").
[13] *Id.* at 2 (directing forests to "analyze the proposed action and alternatives in terms of whether, per 36 CFR 212.5(b)(1), the resulting [road] system is needed").
[14] *See, e.g.*, 63 Fed. Reg. at 4350 (noting in 1998 that "current funding mechanisms and levels are not adequate to maintain roads to the standards originally planned, to assure minimum ecological impacts, as well as to ensure efficient and safe use").

- "meet resource and other management objectives adopted in the relevant land and resource management plan";
- "meet applicable statutory and regulatory requirements";
- "*reflect long-term funding expectations*"; and
- "ensure that the identified system minimizes adverse environmental impacts associated with road construction, reconstruction, decommissioning, and maintenance."

36 C.F.R. §212.5(b)(1) (emphasis added). The Forest Service should take this opportunity to identify the minimum road system for the project area by analyzing whether each road segment meets these minimum road system factors.

In assessing specific road segments, the Forest Service should consider the risks and benefits of each road as analyzed in the travel analysis report, and whether the proposed road management measures are consistent with the recommendations from the travel analysis report. A decision to maintain certain roads within the system dedicates the agency's over-stretched funding and therefore maintenance decisions should also be considered in this analysis. To the extent that the final decision in this project differs from what is recommended in the travel analysis report, the Forest Service should explain that inconsistency. *See, e.g.*, *Smiley v. Citibank*, 517 U.S. 735 (1996) ("Sudden and unexplained change . . . or change that does not take account of legitimate reliance on prior interpretation . . . may be 'arbitrary, capricious [or] an abuse of discretion") (internal citations omitted). In the very least, if the Forest Service decides not to identify the minimum road system for this project area, it must respond and explain why not.

4. Prioritize unneeded roads for decommissioning.

Subpart A directs the agency to "identify the roads on lands under Forest Service jurisdiction that are no longer needed," and therefore should be closed or decommissioned.[15] WildEarth Guardians strongly recommends the Forest Service consider decommissioning at least some roads as part of this project, and if not, explain why in its response to comments. Based on current natural resource conditions, assessed risks from the existing road network, road densities across the landscape, the agency's limited resources, and long-term funding expectations, additional decommissioning is warranted.

Roads that are closed, rather than decommissioned, will continue to fragment wildlife habitat. Plus, costs to maintain these roads are just avoided in the short term; impacts from the roads and risks to natural resources and wildlife remain. Decommissioning more road miles is consistent with the Forest Service's long-standing policy to "manag[e] access within the capability of the land."[16] Road decommissioning may temporarily increase sediment to streams but has dramatic reductions in the long run. The Forest Service's Rocky Mountain Research Station has spent over a decade monitoring the effectiveness of road treatments. A 2012 report evaluating pre and post treatment of roads showed an 80% reduction in sediment delivery to streams when roads were

[15] 36 C.F.R. § 212.5(b)(2). The rule applies to *all* roads, not just National Forest System roads. *See Center for Sierra Nevada v. U.S. Forest Service*, 832 F. Supp. 2d 1138, 1155 (E.D. Cal. 2011) ("The court agrees that during the Subpart A analysis the Forest Service will need to evaluate all roads, including any roads previously designated as open under subpart B, for decommissioning.").

[16] 66 Fed. Reg. at 3208, 3215 (highlighting in 2001 that the Forest Service was "shifting from developing new roads" and increasing "emphasis on maintaining existing roads and improving access in other areas.").

decommissioned.[17] In addition, the 20-year monitoring report of the Northwest Forest Plan confirmed that watersheds that showed the most improvement in condition were those that completed road decommissioning.[18]

Forest Service policy directs the agency to prioritize unneeded roads for decommissioning or other uses. The Forest Service should also consider decommissioning more roads to achieve its goal of establishing a resilient future forest. Decommissioned roads, when seeded with native species, can reduce the spread of invasive species and help restore fragmented forestlands.[19] Closed roads remain on the landscape and therefore would still present a risk to the ecosystem. Little to no maintenance is planned for roads while in storage. In contrast, returning expensive, deteriorating, and seldom used forest roads to the wild would significantly reduce the risks those roads pose to the ecosystem. At bottom, the Forest Service must determine whether the roads within the project area are needed—consistent with subpart A—and if not, prioritize those roads for decommissioning.

5. **Ensure temporary roads are in fact temporary.**

Here, the Forest Service anticipates some amount of temporary road construction will be needed to support the proposed action. Scoping Document at 21. The agency must consider the effects of its proposal to use or reconstruct temporary roads when combined with the effects of its minimum road system.[20] The Forest Service must consider how the proposed temporary roads will detract from the purpose of subpart A of the agency's own rules, to "identify the minimum road system needed for safe and efficient travel and for administration, utilization, and protection of the National Forest System lands." 36 C.F.R. § 212.5(b). The Forest Service has a substantive duty to identify the minimum road system it determines is needed to, *inter alia*, ensure the "identified system minimizes adverse environmental impacts associated with road construction, reconstruction, decommissioning, and maintenance." 36 C.F.R. § 212.5(b). Under NEPA, it also has a duty to consider the effects of its proposed action when added to the existing road and trail system. *Wilderness Society v. U.S. Forest Service*, 850 F. Supp. 2d 1144, 1157-58 (D. Idaho 2012) (holding the Forest Service was arbitrary and capricious to conclude that designating 94 miles of user-created routes as non-system routes would have no significant impact).

Temporary roads must be closed within 10 years of completion of a project, per 16 U.S.C. 1608(a), unless the Forest Service re-evaluates the road and determines it to be necessary for the minimum road system. During the project, however, and for an additional 10 years after completion of the project, the temporary roads will continue to have very real impacts on the landscape. For example, temporary roads will continue to allow for harassment of wildlife, littering, fires, invasive plant

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[17] Nelson N., Black T., Luce C. and R. Cissel, U.S. Forest Service Rocky Mountain Research Station, LRT Monitoring Project Update 2012.

[18] Northwest Forest Plan—The First 20 Years (1994-2013): Watershed Condition Status and Trend (Draft, May 2015), pages 3, 5, 66, 68, *available at* https://reo.gov/monitoring/reports/20yr-report/GTR_AREMP_DRAFT_MAY_2015.pdf (last accessed April 14, 2017) (noting the "decommissioning of roads in riparian areas has multiple benefits according to our model by improving both the riparian scores and typically the sedimentation scores.").

[19] *See* The Wilderness Society, *Transportation Infrastructure and Access on National Forests and Grasslands: A Literature Review* (May 2014), page 11 (Attachment A).

[20] An agency's underlying substantive duty should inform the scope of the agency's NEPA analysis. *Westlands Water Dist. v. U.S. Dept. of the Interior,* 376 F.3d 853, 866 (9th Cir. 2004) (When an agency takes an action "pursuant to a specific statute, the statutory objectives of the project serve as a guide by which to determine the reasonableness of objectives outlined in an EIS.").

distribution, and negative impacts to aquatic and riparian habitat, as well as the fish that depend on that habitat.

The Forest Service should also ensure that the temporary roads will in fact be temporary by requiring a commitment in any commercial logging contracts to decommission all temporary roads within 10 years following completion of this project, and identify monitoring and enforcement to confirm that commitment. In the very least, the Forest Service should ensure it has a mechanism to verify or enforce that the temporary roads will be closed following project completion.

6. Consider a reasonable range of alternatives in terms of proposed road activities.

The alternatives analysis is the "heart" of NEPA, and therefore "an agency must *on its own initiative* study all alternatives that appear reasonable and appropriate for study at the time, and must also look into other significant alternatives that are called to its attention by other agencies, or by the public during the comment period afforded for that purpose." *Dubois v. Dep't of Agriculture*, 102 F.3d 1273, 1291 (1st Cir. 1996), *quoting Seacoast Anti-Pollution League, v. Nuclear Reg. Comm'n*, 598 F.2d 1221, 1231 (1st Cir. 1979) (emphasis from *Dubois* court) (internal citations omitted). The Forest Service should consider a reasonable range of alternatives to the proposed actions, including an alternative that avoids sediment delivery by not building any new temporary roads. It should consider an alternative that includes decommissioning at least some of the roads following use, based on recommendations from the Sierra National Forest's travel analysis report. We urge the Forest Service to consider each of these reasonable alternatives that would still achieve the stated purpose and need (and in some cases better achieve the stated purpose and need) to provide a reasonable range of alternatives.

Appendix 2: Written by the Alliance for the Wild Rockies and Native Ecosystem Council

We submit the following comments to guide the development of the environmental analysis for the proposal. We have reviewed the statutory and regulatory requirements governing National Forest Management projects, as well as the relevant case law, and compiled a check-list of issues that must be included in the EIS for the Project in order for the Forest Service's analysis to comply with the law.

NECESSARY ELEMENTS FOR PROJECT EIS:

1. Disclose all Flathead National Forest Plan requirements for logging/burning projects and explain how the Project complies with them;

2. Disclose the acreages of past, current, and reasonably foreseeable logging, grazing, and road-building activities within the Project area;

3. Solicit and disclose comments from the Montana Department of Fish, Wildlife, and Parks regarding the impact of the Project on wildlife habitat;

4. Solicit and disclose comments from the Montana Department of Environmental Quality regarding the impact of the Project on water quality;

5. Disclose if there are any WQLS streams in the project area and if TMDLs are completed;

6. Disclose the biological assessment for the candidate, threatened, or endangered species with potential and/or actual habitat in the Project area;

7. Disclose the biological evaluation for the sensitive and management indicator species with potential and/or actual habitat in the Project area;

8. Disclose the snag densities in the Project area, and the method used to determine those densities;

9. Disclose the current, during-project, and post-project road densities in the Project area;

10. Disclose the Flathead National Forest's record of compliance with state best management practices regarding stream sedimentation from ground- disturbing management activities;

11. Disclose the Flathead National Forest's record of compliance with its monitoring requirements as set forth in its Forest Plan;

12. Disclose the Flathead National Forest's record of compliance with the additional monitoring requirements set forth in previous DN/FONSIs and RODs on the Flathead National Forest;

13. Disclose the results of the field surveys for threatened, endangered, sensitive, and rare plants in each of the proposed units;

14. Disclose the level of current noxious weed infestations in the Project area and the cause of those infestations;

15. Disclose the impact of the Project on noxious weed infestations and native plant communities;

16. Disclose the amount of detrimental soil disturbance that currently exists in each proposed unit from previous logging and grazing activities;

17. Disclose the expected amount of detrimental soil disturbance in each unit after ground disturbance and prior to any proposed mitigation/remediation;

18. Disclose the expected amount of detrimental soil disturbance in each unit after proposed mitigation/remediation;

19. Disclose the analytical data that supports proposed soil mitigation/remediation measures;

20. Disclose the timeline for implementation;

21. Disclose the funding source for non-commercial activities proposed;

22. Disclose the current level of old growth forest in each third order drainage in the Project area;

23. Disclose the method used to quantify old growth forest acreages and its rate of error based upon field review of its predictions;

24. Disclose the historic levels of mature and old growth forest in the Project area;

25. Disclose the level of mature and old growth forest necessary to sustain viable populations of dependent wildlife species in the area;

26. Disclose the amount of mature and old growth forest that will remain after implementation;

27. Disclose the amount of current habitat for old growth and mature forest dependent species in the Project area;

28. Disclose the amount of habitat for old growth and mature forest dependent species that will remain after Project implementation;

29. Disclose the method used to model old growth and mature forest dependent wildlife habitat acreages and its rate of error based upon field review of its predictions;

30. Disclose the amount of big game (moose and elk) hiding cover, winter range, and security currently available in the area;

31. Disclose the amount of big game (moose and elk) hiding cover, winter range, and security during Project implementation;

32. Disclose the amount of big game (moose and elk) hiding cover, winter range, and security after implementation;

33. Disclose the method used to determine big game hiding cover, winter range, and security, and its rate of error as determined by field review;

34. Disclose and address the concerns expressed by the ID Team in the draft Five-Year Review of the Forest Plan regarding the failure to monitor population trends of MIS, the inadequacy of the Forest Plan old growth standard, and the failure to compile data to establish a reliable inventory of sensitive species on the Forest;

35. Disclose the actions being taken to reduce fuels on private lands adjacent to the Project area and how those activities/or lack thereof will impact the efficacy of the activities proposed for this Project;

36. Disclose the efficacy of the proposed activities at reducing wildfire risk and severity in the Project area in the future, including a two-year, five-year, ten-year, and 20-year projection;

37. Disclose when and how the Flathead National Forest made the decision to suppress natural wildfire in the Project area and replace natural fire with logging and prescribed burning;

38. Disclose the cumulative impacts on the Forest-wide level of the Flathead National Forest's policy decision to replace natural fire with logging and prescribed burning;

39. Disclose how Project complies with the Roadless Rule;

40. Disclose the impact of climate change on the efficacy of the proposed treatments;

41. Disclose the impact of the proposed project on the carbon storage potential of the area;

42. Disclose the baseline condition, and expected sedimentation during and after activities, for all streams in the area;

43. Disclose maps of the area that show the following elements:

a. Past, current, and reasonably foreseeable logging units in the Project area;
b. The cumulative effects of past, current, and reasonably foreseeable logging units;
c. Past, current, and reasonably foreseeable logging units in the Project area;
d. The cumulative effects of past, current, and reasonably foreseeable grazing;
e. Past, current, and reasonably foreseeable grazing allotments in the Project area;
f. Density of human residences within 1.5 miles from the Project unit boundaries;
g. Hiding cover in the Project area according to the Forest Plan definition;
h. Old growth forest in the Project area;
i. Big game security areas;
j. Moose winter range;

44. Rare Plants:

The ESA requires that the Forest Service conserve endangered and threatened species of plants as well as animals. In addition to plants protected under the ESA, the Forest Service identifies species for which population viability is a concern as "sensitive species" designated by the Regional Forester (FSM 2670.44). The response of each of the sensitive plant species to management activity varies by species, and in some cases, is not fully known. Local native vegetation has evolved with and is adapted to the climate, soils, and natural processes such as fire, insect and disease infestations, and windthrow. Any management or lack of management that causes these natural processes to be altered may have impacts on native vegetation, including threatened and sensitive plants. Herbicide application – intended to eradicate invasive plants – also results in a loss of native plant diversity because herbicides kill native plants as well as invasive plants. Although native species have evolved and adapted to natural disturbance such as fire on the landscape, fires primarily occur in mid to late summer season, when annual plants have flowered and set seed. Following fall fires, perennial root-stocks remain underground and plants emerge in the spring. Spring and early summer burns could negatively impact emerging vegetation and destroy annual plant seed.

Transportation Infrastructure and Access on National Forests and Grasslands
A Literature Review
May 2014

Introduction
The Forest Service transportation system is very large with 374,883 miles (603,316 km) of system roads and 143,346 miles (230,693 km) of system trails. The system extends broadly across every national forest and grasslands and through a variety of habitats, ecosystems and terrains. An impressive body of scientific literature exists addressing the various effects of roads on the physical, biological and cultural environment – so much so, in the last few decades a new field of "road ecology" has emerged. In recent years, the scientific literature has expanded to address the effects of roads on climate change adaptation and conversely the effects of climate change on roads, as well as the effects of restoring lands occupied by roads on the physical, biological and cultural environments.

The following literature review summarizes the most recent thinking related to the environmental impacts of forest roads and motorized routes and ways to address them. The literature review is divided into three sections that address the environmental effects of transportation infrastructure on forests, climate change and infrastructure, and creating sustainable forest transportation systems.

I. Impacts of Transportation Infrastructure and Access to the Ecological Integrity of Terrestrial and Aquatic Ecosystems and Watersheds
II. Climate Change and Transportation Infrastructure Including the Value of Roadless Areas for Climate Change Adaptation
III. Sustainable Transportation Management in National Forests as Part of Ecological Restoration

I. Impacts of Transportation Infrastructure and Access to the Ecological Integrity of Terrestrial and Aquatic Ecosystems and Watersheds

It is well understood that transportation infrastructure and access management impact aquatic and terrestrial environments at multiple scales, and, in general, the more roads and motorized routes 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; entire books have been written on the topic, e.g., Forman et al. (2003), and a new scientific field called "road ecology" has emerged. Road ecology research centers have been created including the Western

Transportation Institute at Montana State University and the Road Ecology Center at the University of California - Davis.[1]

Below, we provide a summary of the current understanding on the impacts of roads and access allowed by road networks to terrestrial and aquatic ecosystems, drawing heavily on Gucinski et al. (2000). Other notable recent peer-reviewed literature reviews on roads include Trombulak and Frissell (2000), Switalski et al. (2004), Coffin (2007), Fahrig and Rytwinski (2009), and Robinson et al. (2010). Recent reviews on the impact of motorized recreation include Joslin and Youmans (1999), Gaines et al. (2003), Davenport and Switalski (2006), Ouren et al. (2007), and Switalski and Jones (2012). These peer-reviewed summaries provide additional information to help managers develop more sustainable transportation systems

Impact on geomorphology and hydrology

The construction or presence of forest roads can dramatically change the hydrology and geomorphology of a forest system leading to reductions in the quantity and quality of aquatic habitat. While there are several mechanisms that cause these impacts (Wemple et al. 2001 , Figure 1), most fundamentally, compacted roadbeds reduce rainfall infiltration, intercepting and concentrating water, and providing a ready source of sediment for transport (Wemple et al. 1996, Wemple et al. 2001). In fact, roads 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).

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

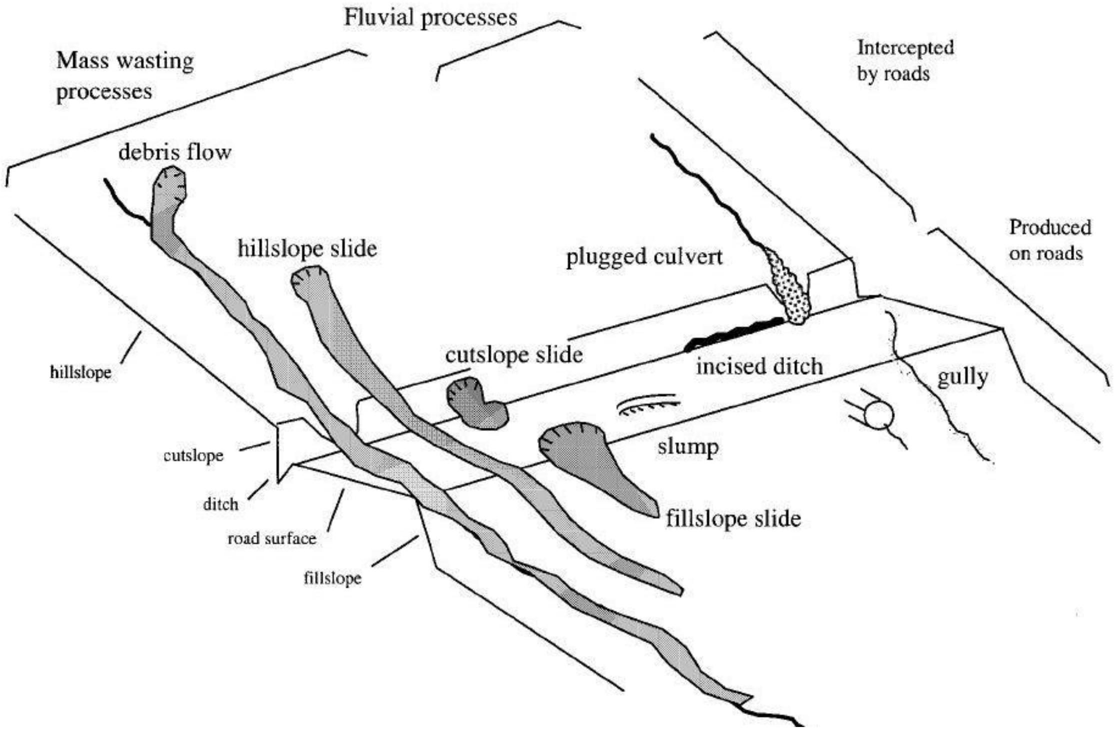

Figure 1: Typology of erosional and depositional features produced by mass-wasting and fluvial processes associate with forest roads (reprinted from Wemple et al. 2001)

Erosion of sediment from roads occurs both chronically and catastrophically. Every time it rains, sediment from the road surface and from cut- and fill-slopes is picked up by rainwater that flows into and on roads (fluvial erosion). The sediment that is entrained in surface flows are often concentrated into road ditches and culverts and directed into streams. The degree of fluvial erosion varies by geology and geography, and increases with increased motorized use (Robichaud et al. 2010). Closed roads produce less sediment, and Foltz et al. (2009) found a significant increase in erosion when closed roads were opened and driven upon.

Roads also precipitate catastrophic failures of road beds and fills (mass wasting) during large storm events leading to massive slugs of sediment moving into waterways (Endicott 2008; Gucinski et al. 2000). This typically occurs when culverts are undersized and cannot handle the volume of water, or they simply become plugged with debris. The saturated roadbed can fail entirely and result in a landslide, or the blocked stream crossing can erode the entire fill down to the original stream channel.

The erosion of road- and trail-related sediment and its subsequent movement into stream systems affects the geomorphology of the drainage system in a number of ways. The magnitude of their effects varies by climate, geology, road age, construction / maintenance practices and storm history. It directly alters channel morphology by embedding larger gravels as well as 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). 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). 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).

Impacts on aquatic habitat and fish
Roads can have dramatic and lasting impacts on fish and aquatic habitat. 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 macro-invertebrate populations that are a food source to many fish species (Rhodes et al. 1994, Joslin and Youmans 1999, Gucinski et al. 2000, Endicott 2008). 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, refugi, and water temperature) (Gucinski et al. 2000).

Roads can also act as barriers to migration (Gucinski et al. 2000). Where roads cross streams, road engineers usually place culverts or bridges. Culverts in particular 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. Undersized culverts and bridges can infringe upon the channel or floodplain and trap sediment causing the stream to become too shallow and/or warm such that fish will not migrate past the structure. This is problematic for many aquatic species but especially for anadromous species that must migrate upstream to spawn. Well-known native aquatic species affected by roads include salmon such as coho (*Oncorhynchus kisutch*), chinook (*O. tshawytscha*), and chum (*O. keta*); steelhead (*O. mykiss*); and a variety of trout species including bull trout (*Salvelinus confluentus*) and cutthroat trout (*O. clarki*), as well as other native fishes and amphibians (Endicott 2008).

Impacts on terrestrial habitat and wildlife
Roads and trails impact wildlife through a number of mechanisms including: direct mortality (poaching, hunting/trapping) changes in movement and habitat use patterns (disturbance/avoidance), as well as indirect impacts including alteration of the adjacent habitat and interference with predatory/prey relationships (Wisdom et al. 2000, Trombulak and Frissell 2000). Some of these impacts result from the road itself, and some result from the uses on and around the roads (access). Ultimately, roads have been found to reduce the abundance and distribution of several forest species (Fayrig and Ritwinski 2009, Benítez-López et al. 2010).

Table 1: Road- and recreation trail-associated factors for wide-ranging carnivores (Reprinted from Gaines et al. (2003)[2]

[2] For a list of citations see Gaines et al. (2003)

Focal species	Road-associated factors	Motorized trail-associated factors	Nonmotorized trail-associated factors
Grizzly bear	Poaching Collisions Negative human interactions Displacement or avoidance	Poaching Negative human interactions Displacement or avoidance	Poaching Negative human interactions Displacement or avoidance
Lynx	Down log reduction Trapping Collisions Disturbance at a specific site	Disturbance at a specific site Trapping	Disturbance at a specific site
Gray wolf	Trapping Poaching Collisions Negative human interactions Disturbance at a specific site Displacement or avoidance	Trapping Disturbance at a specific site	Trapping Disturbance at a specific site
Wolverine	Down log reduction Trapping Disturbance at a specific site Collisions	Trapping Disturbance at a specific site	Trapping Disturbance at a specific site

Direct mortality and disturbance from road and trail use impacts many different types of species. For example, wide-ranging carnivores can be significantly impacted by a number of factors including trapping, poaching, collisions, negative human interactions, disturbance and displacement (Gaines et al. 2003, Table 1). Hunted game species such as elk (*Cervus canadensis*), become more vulnerable from access allowed by roads and motorized trails resulting in a reduction in effective habitat among other impacts (Rowland et al. 2005, Switalski and Jones 2012). Slow-moving migratory animals such as amphibians, and reptiles who use roads to regulate temperature are also vulnerable (Gucinski et al. 2000, Brehme et al. 2013).

Habitat alteration is a significant consequence of roads as well. 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 road-avoidance zones a kilometer or more away from a road (Table 2). 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/mi^2 (not an uncommon road density in national forests) and where the edge-affected zone is estimated to be 500 ft from the center of the road to each side, the edge-affected zone is 56% of the total acreage.

Table 2: A summary of some documented road-avoidance zones for various species (adapted from Robinson et al. 2010).

Species	Avoidance zone m (ft)	Type of disturbance	Reference
Snakes	650 (2133)	Forestry roads	Bowles (1997)
Salamander	35 (115)	Narrow forestry road, light traffic	Semlitsch (2003)
Woodland birds	150 (492)	Unpaved roads	Ortega and Capen (2002)
Spotted owl	400 (1312)	Forestry roads, light traffic	Wasser et al. (1997)
Marten	<100 (<328)	Any forest opening	Hargis et al. (1999)
Elk	500–1000 (1640-3281)	Logging roads, light traffic	Edge and Marcum (1985)
	100–300 (328-984)	Mountain roads depending on traffic volume	Rost and Bailey (1979)
Grizzly bear	3000 (9840)	Fall	Mattson et al. (1996)
	500 (1640)	Spring and summer	
	883 (2897)	Heavily traveled trail	Kasworm and Manley (1990)
	274 (899)	Lightly traveled trail	
	1122 (3681)	Open road	Kasworm and Manley (1990)
	665 (2182)	Closed road	
Black bear	274 (899)	Spring, unpaved roads	Kasworm and Manley (1990)
	914 (2999)	Fall, unpaved roads	

Roads and trails 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 (Wisdom et al. 2000).

Recent reviews have synthesized the impacts of roads on animal abundance and distribution. 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. Benítez-López et al. (2010) conducted a meta-analysis on the effects of roads and infrastructure proximity on mammal and bird populations. They found a significant pattern of avoidance and a reduction in bird and mammal populations in the vicinity of infrastructure.

Road density[3] thresholds for fish and wildlife

[3] 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.

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 road densities certainly affect other species – for instance, reptiles and amphibians. Gray wolves (*Canis lupus*) in the Great Lakes region and elk 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/km^2 (1.0 mi/mi^2). Several studies have since substantiated their claim (Robinson et al. 2010, Table 3).

A number of studies at broad scales have also shown that higher road densities generally lead to greater impacts to aquatic habitats and fish density (Table 3). Carnefix and Frissell (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/km^2 (1.0 mi/mi^2) or less" (p. 1).

Table 3: A summary of some road-density thresholds and correlations for terrestrial and aquatic species and ecosystems (reprinted from Robinson et al. 2010).

Species (Location)	**Road density (mean, guideline, threshold, correlation)**	**Reference**
Wolf (Minnesota)	0.36 km/km2 (mean road density in primary range); 0.54 km/km^2 (mean road density in peripheral range)	Mech et al. (1988)
Wolf	>0.6 km/km^2 (absent at this density)	Jalkotzy et al. (1997)
Wolf (Northern Great Lakes region)	>0.45 km/km^2 (few packs exist above this threshold); >1.0 km/km^2 (no pack exist above this threshold)	Mladenoff et al. (1995)
Wolf (Wisconsin)	0.63 km/km^2 (increasing due to greater human tolerance	Wydeven et al. (2001)
Wolf, mountain lion (Minnesota, Wisconsin, Michigan)	0.6 km/km^2 (apparent threshold value for a naturally functioning landscape containing sustained populations)	Thiel (1985); van Dyke et al. (1986); Jensen et al. (1986); Mech et al. (1988); Mech (1989)
Elk (Idaho)	1.9 km/km^2 (density standard for habitat effectiveness)	Woodley 2000 cited in Beazley et al. 2004
Elk (Northern US)	1.24 km/km^2 (habitat effectiveness decline by at least 50%)	Lyon (1983)
Elk, bear, wolverine, lynx, and others	0.63 km/km^2 (reduced habitat security and increased mortality)	Wisdom et al. (2000)
Moose (Ontario)	0.2-0.4 km/km2 (threshold for pronounced response)	Beyer et al. (2013)
Grizzly bear (Montana)	>0.6 km/km^2	Mace et al. (1996); Mattson et al. (1996)
Black bear (North Carolina)	>1.25 km/km^2 (open roads); >0.5 km/km2 (logging roads); (interference with use of habitat)	Brody and Pelton (1989)
Black bear	0.25 km/km^2 (road density should not exceed)	Jalkotzy et al. (1997)
Bobcat (Wisconsin)	1.5 km/km^2 (density of all road types in home range)	Jalkotzy et al. (1997)

Large mammals	>0.6 km/km^2 (apparent threshold value for a naturally functioning landscape containing sustained popula-tions)	Forman and Hersperger (1996)
Bull trout (Montana)	Inverse relationship of population and road density	Rieman et al. (1997); Baxter et al. (1999)
Fish populations (Medicine Bow National Forest)	(1) Positive correlation of numbers of culverts and stream crossings and amount of fine sediment in stream channels (2) Negative correlation of fish density and numbers of culverts	Eaglin and Hubert (1993) cited in Gucinski et al. (2001)
Macroinvertebrates	Species richness negatively correlated with an index of road density	McGurk and Fong (1995)
Non-anadromous salmonids (Upper Columbia River basin)	(1) Negative correlation likelihood of spawning and rearing and road density (2) Negative correlation of fish density and road density	Lee et al. (1997)

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 (Gucinski et al. 2000). For example, a study on the Medicine Bow National Forest (WY) found as the number of culverts and stream crossings increased, so did the amount of sediment in stream channels (Eaglin and Hubert 1993). They also found a negative correlation with fish density and the number of culverts. Invertebrate communities can also be impacted. McGurk and Fong (1995) report a negative correlation between an index of road density with macroinvertebrate diversity.

The U.S. Fish and Wildlife Service's Final Rule listing bull trout as threatened (USDI Fish and Wildlife Service 1999) addressed road density, stating:

> "… 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" (USDI Fish and Wildlife Service 1999, p. 58922).

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, they 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.

Impacts on other resources
Roads and motorized trails 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). Furthermore, Baxter (2002) found that off-road vehicles (ORVs) can be a significant source of fire ignitions on forestlands. Roads can 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.

Finally, access allowed by roads and trails can increase of ORV and motorized use in remote areas threatening archaeological and historic sites. Increased visitation has resulted in intentional and unintentional damage to many cultural sites (USDI Bureau of Land Management 2000, Schiffman 2005).

II. Climate Change and Transportation Infrastructure including the value of roadless areas for climate change adaptation

As climate change impacts grow more profound, forest managers must consider the impacts on the transportation system as well as from the transportation system. In terms of the former, changes in precipitation and hydrologic patterns will strain infrastructure at times to the breaking point resulting in damage to streams, fish habitat, and water quality as well as threats to public safety. In terms of the latter, the fragmenting effect of roads on habitat will impede the movement of species which is a fundamental element of adaptation. Through planning, forest managers can proactively address threats to infrastructure, and can actually enhance forest resilience by removing unneeded roads to create larger patches of connected habitat.

Impact of climate change and roads on transportation infrastructure
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 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).

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. 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.

Modifying infrastructure to increase resilience
To prevent or reduce road failures, culvert blow-outs, and other associated hazards, 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 2012a, USDA Forest Service 2011, Table 4).

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 2011a). 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 2011a, Table 4).

Table 4: Current and expected sensitivities of fish to climate change on the Olympic Peninsula, associated adaptation strategies and action for fisheries and fish habitat management and relevant to transportation management at Olympic National Forest and Olympic National Park (excerpt reprinted from USDA Forest Service 2011a).

Current and expected sensitivites	**Adaptation strategies and actions**
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.
Decrease in area of headwater streams	• Continue to correct culvert fish passage barriers. • Consider re-prioritizing culvert fish barrier correction projects.
Decrease in habitat quantity and connectivity for species that use headwater streams	• Restore habitat in degraded headwater streams that are expected to retain adequate summer streamflow (ONF).

In December 2012, the USDA 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 2012a, p. 22-23).

Reducing fragmentation to enhance aquatic and terrestrial species adaptation
Decommissioning and upgrading roads and thus reducing the amount of fine sediment deposited on salmonid nests 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).

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. For wildlife, road decommissioning can reduce the many stressors associated with roads. Road decommissioning restores habitat by providing security and food such as grasses and fruiting shrubs for wildlife (Switalski and Nelson 2011).

Forests fragmented by roads and motorized trail networks will likely demonstrate less resistance and resilience to stressors, such as weeds. As a forest is fragmented and there is more edge habitat, Noss (2001) predicts that weedy species with effective dispersal mechanisms will increasingly benefit at the expense of native species. However, decommissioned roads when seeded with native species can reduce the spread of invasive species (Grant et al. 2011), and help restore fragmented forestlands. Off-road vehicles with large knobby tires and large undercarriages are also a key vector for weed spread (e.g., Rooney 2006). Strategically closing and decommissioning motorized routes, especially in roadless areas, will reduce the spread of weeds on forestlands (Gelbard and Harrison 2003).

Transportation infrastructure and carbon sequestration
The topic of the relationship of road restoration and carbon has only recently been explored. There is the potential for large amounts of carbon (C) to be sequestered by reclaiming roads. When roads are decompacted during reclamation, vegetation and soils can develop more

rapidly and sequester large amounts of carbon. A recent study estimated total soil C storage increased 6 fold to 6.5 x 107g C/km (to 25 cm depth) in the northwestern US compared to untreated abandoned roads (Lloyd et al. 2013). Another recent study concluded that reclaiming 425 km of logging roads over the last 30 years in Redwood National Park in Northern California resulted in net carbon savings of 49,000 Mg carbon to date (Madej et al. 2013, Table 5).

Kerekvliet et al. (2008) published a Wilderness Society briefing memo on the impact to carbon sequestration from road decommissioning. 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.

Table 5. Carbon budget implications in road decommissioning projects (reprinted from Madej et al. 2013).

Road Decommissioning Activities and Processes	Carbon Cost	Carbon Savings
Transportation of staff to restoration sites (fuel emissions)	X	
Use of heavy equipment in excavations (fuel emissions)	X	
Cutting trees along road alignment during hillslope recontouring	X	
Excavation of road fill from stream crossings		X
Removal of road fill from unstable locations		X
Reduces risk of mass movement		X
Post-restoration channel erosion at excavation sites	X	
Natural revegetation following road decompaction		X
Replanting trees		X
Soil development following decompaction		X

Benefits of roadless areas and roadless area networks to climate change adaptation
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)[4] as well as in the Final Environmental Impact Statement (FEIS) for the RACR[5], and

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

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).

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 (USDA Forest Service 2011b) establishes that increasing connectivity and reducing fragmentation are short and long term actions the Forest Service should take to facilitate adaptation to climate change.[6] 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."[7] Similarly, the National Fish, Wildlife and Plants Climate Adaptation Partnership's Adaptation Strategy (2012) calls for creating an ecologically-connected network of conservation areas.[8]

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

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

[7] 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."

[8] 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.

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.

III. Sustainable Transportation Management in National Forests as Part of Ecological Restoration

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 2001). 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. Road densities in national forests often 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.[9] Most of the road maintenance funding is directed to the passenger car roads, while the remaining roads suffer from neglect. As a result, the Forest Service currently has a $3.7 billion road maintenance backlog that grows every year. 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 and maintained because they are higher level access roads. The remaining roads sit generally unneeded and under-maintained – arguably a growing ecological and fiscal liability.

Current Forest Service management direction is to identify and implement a sustainable transportation system.[10] 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. It is

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

[10] 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))"

reasonable to define a sustainable transportation system as one where all the routes are constructed, located, and maintained with best management practices, and social and environmental impacts are minimized. This, of course, is easier said than done, since the reality is that even the best roads and trail networks can be problematic simply because they exist and usher in land uses that without the access would not occur (Trombulak and Frissell 2000, Carnefix and Frissell 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, what was sustainable may no longer be sustainable under climate change since roads designed to meet older climate criteria may no longer hold up under new climate scenarios (USDA Forest Service 2010, USDA Forest Service 2011b, USDA Forest Service 2012a, AASHTO 2012).

Forest Service efforts to move toward a more sustainable transportation system
The Forest Service has made efforts to make its transportation system more sustainable, but still has considerable work to do. In 2001, the Forest Service tried to address the issue by promulgating the Roads Rule[11] with the purpose of working toward a sustainable road system (USDA 2001). The Rule directed every national forest to identify a minimum necessary road system and identify unneeded roads for decommissioning. To do this, the Forest Service developed the Roads Analysis Process (RAP), and published Gucinski et al. (2000) to provide the scientific foundation to complement the RAP. In describing the RAP, Gucinski et al. (2000) writes:

> "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" (p. 10).

Most national forests have completed RAPs, although most only looked at passenger vehicle roads which account for less than 20% of the system's miles. The Forest Service Washington Office in 2010 directed that forests complete a Travel Analysis Process (TAP) by the end of fiscal year 2015, which must address all roads and create a map and list of roads identifying which are likely needed and which are not. Completed TAPs will provide a blueprint for future road decommissioning and management, they will not constitute compliance with the Roads Rule, which clearly requires the identification of the minimum roads system and roads for decommissioning. Almost all forests have yet to comply with subpart A.

The Forest Service in 2005 then tried to address the off-road portion of this issue by promulgating subpart B of the Travel Managemenr Rule,[12] with the purpose of curbing the most serious impacts associated with off-road vehicle use. Without a doubt, securing summer-time travel management plans was an important step to curbing the worst damage. However, much work remains to be done to approach sustainability, especially since many national forests used the travel management planning process to simply freeze the footprint of motorized routes, and did not try to re-design the system to make it more ecologically or socially sustainable. Adams

[11] 36 CFR 215 subpart A
[12] 36 CFR 212 subpart B

and McCool (2009) considered this question of how to achieve sustainable motorized recreation and concluded that:

> As the agencies move to revise [off-road vehicle] 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 11644....[13]
>
> …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.[14]

The Forest Service only now is contemplating addressing the winter portion of the issue, forced by a lawsuit challenging the Forest Service's inadequate management of snowmobiles. The agency is expected to issue a third rule in the fall of 2014 that will trigger winter travel management planning.

Strategies for identifying a minimum road system and prioritizing restoration
Transportation Management plays an integral role in the restoration of Forestlands. Reclaiming and obliterating roads is key to developing a sustainable transportation system. Numerous authors have suggested removing roads 1) to restore water quality and aquatic habitats Gucinski et al. 2000), and 2) to improve habitat security and restore terrestrial habitat (e.g., USDI USFWS 1993, Hebblewhite et al. 2009).

Creating a minimum road system through road removal will increase connectivity and decrease fragmentation across the entire forest system. However, at a landscape scale, certain roads and road segments pose greater risks to terrestrial and aquatic integrity than others. Hence, restoration strategies must focus on identifying and removing/mitigating the higher risk roads. Additionally, areas with the highest ecological values, such as being adjacent to a roadless area, may also be prioritized for restoration efforts. Several methods have been developed to help prioritize road reclamation efforts including GIS-based tools and best management practices (BMPs). It is our hope that even with limited resources, restoration efforts can be prioritized and a more sustainable transportation system created.

GIS-based tools

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[13] 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

- *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).

[14] Page 105.

Girvetz and Shilling (2003) developed a novel and inexpensive way to analyze environmental impacts from road systems using the Ecosystem Management Decision Support program (EMDS). EMDS was originally developed by the United States Forest Service, as a GIS-based decision support tool to conduct ecological analysis and planning (Reynolds 1999). Working in conjunction with Tahoe National Forest managers, Girvetz and Shilling (2003) used spatial data on a number of aquatic and terrestrial variables and modeled the impact of the forest's road network. The network analysis showed that out of 8233 km of road analyzed, only 3483 km (42%) was needed to ensure current and future access to key points. They found that the modified network had improved patch characteristics, such as significantly fewer "cherry stem" roads intruding into patches, and larger roadlessness.

Shilling et al. (2012) later developed a recreational route optimization model using a similar methodology and with the goal of identifying a sustainable motorized transportation system for the Tahoe National Forest (Figure 2). Again using a variety of environmental factors, 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" (p. 392**).**

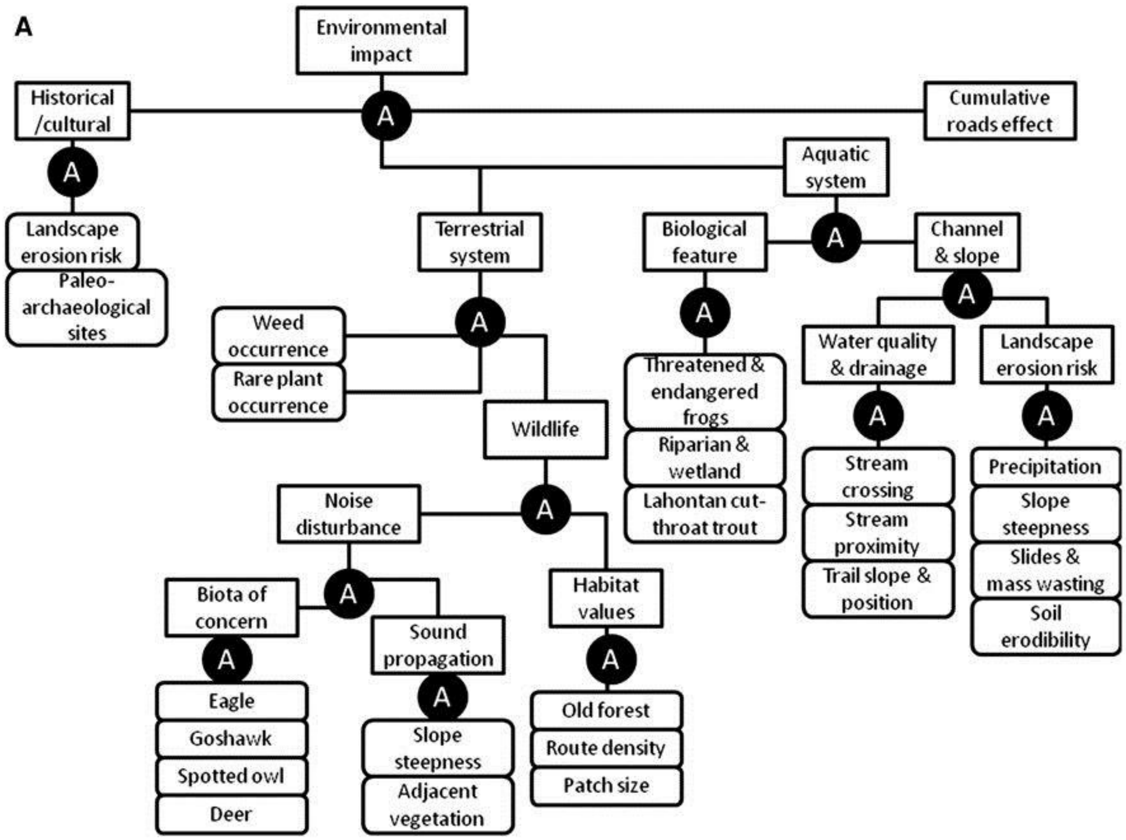

Figure 2: A knowledge base of contributions of various environmental conditions to the concept ''environmental impact'' [of motorized trails]. Rectangles indicate concepts, circles indicate Boolean logic operators, and rounded rectangles indicate sources of environmental data. (Reprinted from Shilling et al. 2012)

The Wilderness Society in 2012 also developed 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.[15]

[15] 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

Best management practices (BMPs)
BMPs have also been developed to help create more sustainable transportation systems and identify restoration opportunities. BMPs provide science-based criteria and standards that land managers follow in making and implementing decisions about human uses and projects that affect natural resources. Several states have developed BMPs for road construction, maintenance and decommissioning practices (e.g., Logan 2001, Merrill and Cassaday 2003, USDA Forest Service 2012b).

Recently, BMPs have been developed for addressing motorized recreation. Switalski and Jones (2012) published, "*Off-Road Vehicle Best Management Practices for Forestlands: A Review of Scientific Literature and Guidance for Managers*." This document reviews the current literature on the environmental and social impacts of off-road vehicles (ORVs), and establishes a set of Best Management Practices (BMPs) for the planning and management of ORV routes on forestlands. The BMPs were designed to be used by land managers on all forestlands, and is consistent with current forest management policy and regulations. They give guidance to transportation planners on where how to place ORV routes in areas where they will reduce use conflicts and cause as little harm to the environment as possible. These BMPs also help guide managers on how to best remove and restore routes that are redundant or where there is an unacceptable environmental or social cost.

References
AASHTO. 2012. Adapting Infrastructure to Extreme Weather Events: Best Practices and Key Challenges. Background Paper. AASHTO Workshop. Traverse City, Michigan, May 20, 2012. Available at: http://climatechange.transportation.org/pdf/adapt_background5-20-12.pdf.

Adams, J.C., and S.F. McCool. 2009. Finite recreation opportunities: The Forest Service, the Bureau of Land Management, and off-road vehicle management. Natural Areas Journal 49: 45–116.

Anderson, H.M., C. Gaolach, J. Thomson, and G. Aplet. 2012. Watershed Health in Wilderness, Roadless, and Roaded Areas of the National Forest System. Wilderness Society Report. 11 p.

Battin J., M.W. Wiley, M.H. Ruckelshaus, R.N. Palmer, E. Korb, K.K. Bartz, and H. Imaki. 2007. Projected impacts of climate change on salmon habitat restoration. Proceedings of the National Academy of Sciences of the United States of America 104: 6720–6725.

Baxter, C.V., C.A. Frissell, and F.R. Hauer. 1999. Geomorphology, logging roads, and the distribution of bull trout spawning in a forested river basin: implications for management and conservation. Transactions of the American Fisheries Society 128: 854–867.

Baxter, G. 2002. All terrain vehicles as a cause of fire ignition in Alberta forests. Advantage (Publication of the Forest Engineering Research Institute of Canada) 3(44): 1-7.

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

Beazley, K., T. Snaith, F. MacKinnon, and D. Colville. 2004. Road density and the potential impacts on wildlife species such as American moose in mainland Nova Scotia. Proceedings of the Nova Scotia Institute of Science 42: 339-357.

Benítez-López , A., R. Alkemade, and P.A. Verweij. 2010. The impacts of roads and other infrastructure on mammal and bird populations: a meta-analysis. Biological Conservation 143: 1307-1316.

Beyer, H.L., R. Ung, D.L. Murray, and M.J. Fortin. 2013 Functional responses, seasonal variation and thresholds in behavioural responses of moose to road density. Journal of Applied Ecology 50: 286–294.

Brehme, C.S., and J.A. Tracey, L.R. McClenaghan, and R.N. Fisher. 2013. Permeability of roads to movement of scrubland lizards and small mammals. Conservation Biology 27(4): 710–720.

Bowles, A.E. 1997. Responses of wildlife to noise. In Wildlife and recreationists: coexistence through management and research. Edited by R.L. Knight and K.J. Gutzwiller. Island Press, Washington, DC. p. 109–156.

Brody, A.J., and M.R. Pelton. 1989. Effects of roads on black bear movements in western North Carolina. Wildlife Society Bulletin 17: 5-10.

Carnefix, G., and C. A. Frissell. 2009. Aquatic and Other Environmental Impacts of Roads: The Case for Road Density as Indicator of Human Disturbance and Road-Density Reduction as Restoration Target; A Concise Review. Pacific Rivers Council Science Publication 09-001. Pacific Rivers Council, Portland, OR and Polson, MT. Available at: http://www.pacificrivers.org/science-research/resources-publications/road-density-as-indicator/download

Coffin, A. 2006. From roadkill to road ecology: A review of the ecological effects of roads. Journal of Transport Geography 15: 396-406.

Crist, M.R., and B. Wilmer. 2002. Roadless Areas: The Missing Link in Conservation. The Wilderness Society, Washington D.C.

Davenport, J., and T.A. Switalski. 2006. Environmental impacts of transport related to tourism and leisure activities. In: The ecology of transportation: managing mobility for the environment, editors: J Davenport and Julia Davenport. Dordrecht, Netherlands: Kluwer Academic Publishers. 333-360. Available at: http://www.wildlandscpr.org/files/uploads/PDFs/d_Switalski_2006_Enviro_impacts_of_transport.pdf

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.

DeVelice, R., and J.R. Martin. 2001. Assessing the extent to which roadless areas complement the conservation of biological diversity. Ecological Applications 11(4): 1008-1018.

Endicott, D. 2008. National Level Assessment of Water Quality Impairments Related to Forest Roads and Their Prevention by Best Management Practices. A Report Prepared by the Great Lakes Environmental Center for the Environmental Protection Agency, Office of Water, December 4, 2008. 259 pp.

Edge, W.D., and C.L. Marcum. 1985. Movements of elk in relation to logging disturbances. Journal of Wildlife Management 49(4): 926–930.

Fahrig, L., and T. Rytwinski. 2009. Effects of roads on animal abundance: an empirical review and synthesis. Ecology and Society 14(1): 21. Available at: http://www.ecologyandsociety.org/vol14/iss1/art21/.

Foltz, R.B. N.S. Copeland, and W.J. Elliot. 2009. Reopening abandoned forest roads in northern Idaho, USA: Quantification of runoff, sediment concentration, infiltration, and interrill erosion parameters. Journal of Environmental Management 90: 2542–2550.

Forman, R. T. T., and A.M. Hersperger. 1996. Road ecology and road density in different landscapes, with international planning and mitigation solutions. Pages 1–22. IN: G. L. Evink, P. Garrett, D. Zeigler, and J. Berry (eds.), Trends in Addressing Transportation Related Wildlife Mortality. No. FLER- 58-96, Florida Department of Transportation, Tallahassee, Florida.

Foreman, R.T.T., D. Sperling, J.A. Bissonette et al. 2003. Road Ecology – Science and Solutions. Island Press. Washington, D.C. 504 p.

Furniss, M.J., T.D. Roelofs, and C.S. Yee. 1991. Road construction and maintenance. In: Meehan, W.R., ed. Influences of forest and rangeland management on salmonid fishes and their habitats. Spec. Publ. 19. Bethesda, MD: American Fisheries Society. p. 297-323.

Gaines, W.L., P. Singleton, and R.C. Ross. 2003. Assessing the cumulative effects of linear recreation routes on wildlife habitats on the Okanogan and Wenatchee National Forests. Gen. Tech. Rep. PNW-GTR-586. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 79 p. Available at: http://www.montanawildlife.com/projectsissues/Assessingthecumulativeeffectsoflinearrecreationroutesonwildlifehabitats.pdf

Gelbard, J.L., and S. Harrison. 2003. Roadless habitats as refuges for native grasslands: interactions with soil, aspect, and grazing. Ecological Applications 13(2): 404-415.

Girvetz, E., and F. Shilling. 2003. Decision Support for Road System Analysis and Modification on the Tahoe National Forest. Environmental Management 32(2): 218–233

Grant, A., C.R. Nelson, T.A. Switalski, and S.M. Rinehart. 2011. Restoration of native plant communities after road decommissioning in the Rocky Mountains: effect of seed mix composition & soil properties on vegetatative establishment. Restoration Ecology 19: 160-169.

Gucinski, M., J. Furniss, R. Ziemer, and M.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 p. Available at: http://www.fs.fed.us/pnw/pubs/gtr509.pdf.

Hargis, C.D., J.A. Bissonette, and D.T. Turner. 1999. The influence of forest fragmentation and landscape pattern on American martens. Journal of Applied Ecology 36(1): 157–172.

Hebblewhite, M., R.H. Munro, E.H Merrill. 2009. Trophic consequences of postfire logging in a wolf-ungulate system. Forest Ecology and Management 257(3): 1053-1062.

Holman, I.P., R.J. Nicholls, P.M. Berry, P.A. Harrison, E. Audsley, S. Shackley, and M.D.A. Rounsevell. 2005. A regional, multi-sectoral and integrated assessment of the impacts of climate and socio-economic change in the UK. Part II. Results. Climatic Change 71: 43-73.

Jalkotzy, M.G., P.I. Ross, and M.D. Nasserden. 1997. The effects of linear developments on wildlife: a review of selected scientific literature. Prepared for Canadian Association of Petroleum Producers. Arc Wildlife Services, Ltd., Calgary, AB. 115 p.

Jensen W.F., T.K. Fuller, and W.L. Robinson. 1986. Wolf (*Canis lupus*) distribution on the Onterio-Michigan border near Sault Ste. Marie. Canadian Field-Naturalist 100: 363-366.

Joslin, G., and H. Youmans, coordinators. 1999. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society. 307 p. Available at: http://joomla.wildlife.org/Montana/index

Kasworm, W.F., and T.L. Manley. 1990. Road and trail influences on grizzly bears and black bears in northwest Montana. International Conference on Bear Research and Management 8: 79-84.

Kerkvliet, J., J. Hicks, and B. Wilmer. 2008. Carbon Sequestered when Unneeded National Forest Roads are Revegetated. The Wilderness Society Briefing Memo. Available at: http://wilderness.org/sites/default/files/legacy/brief_carbonandroads.pdf.

Lee, D., J. Sedell, B.E. Rieman, R. Thurow, and J. Williams. 1997. Broad-scale assessment of aquatic species and habitats. In: An assessment of ecosystem components in the interior Columbia basin and portions of the Klamath and Great Basins. Edited by T.M. Quigley and S.J. Arbelbide. General Technical ReportPNW-GTR-405. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. Vol III. p. 183–196.

Lloyd, R., K. Lohse, and T.P.A. Ferre. 2013. Influence of road reclamation techniques on forest ecosystem recovery. Frontiers in Ecology and the Environment 11(2): 75-81.

Loucks, C., N. Brown, A. Loucks, and K. 2003. USDA Forest Service roadless areas: potential biodiversity conservation reserves. Conservation Ecology 7(2): 5. Available at: http://www.ecologyandsociety.org/vol7/iss2/art5/

Logan, R. 2001. Water Quality BMPs for Montana Forests. Montana Department of Environmental Quality. Missoula, MT. 60p. Available at:

https://dnrc.mt.gov/Forestry/Assistance/Practices/Documents/2001WaterQualityBMPGuide.pdf

Lyon, L.J. 1983. Road density models describing habitat effectiveness for elk. Journal of Forestry 81: 592-595.

Mace, R.D., J.S. Waller, T.L. Manley, L.J. Lyon, and H. Zuuring. 1996. Relationships among grizzly bears, roads and habitat in the Swan Mountains, MT. Journal of Applied Ecology. 33: 1395-1404.

Madej, M., J. Seney, and P. van Mantgem. 2013. Effects of road decommissioning on carbon stocks, losses, and emissions in north coastal California. Restoration Ecology 21(4): 439–446.

Mattson, D.J., S. Herrero, R.G. Wright, and C.M. Pease. 1996. Science and management of Rocky Mountain grizzly bears. Conservation Biology 10(4): 1013-1025.

McCaffery M., T.A. Switalski, and L. Eby. 2007. Effects of road decommissioning on stream habitat characteristics in the South Fork Flathead River, Montana. Transactions of the American Fisheries Society 136: 553-561.

McGurk, B.J., and D.R. Fong, 1995. Equivalent roaded area as a measure of cumulative effect of logging. Environmental Management 19: 609-621.

Mech, L D. 1989. Wolf population survival in an area of high road density. American Midland Naturalist 121: 387-389.

Mech, L. D., S.H. Fritts, G.L. Radde, and W.J. Paul. 1988. Wolf distribution and road density in Minnesota. Wildlife Society Bulletin 16: 85-87.

Merrilll, B.R., and E. Cassaday. 2003. Best Management Practices for Road Rehabilitation – Road – Stream Crossing Manual. California State Parks. Eureka, CA. 25p. Available at: http://www.parks.ca.gov/pages/23071/files/streamcrossingremovalbmp5_03.pdf

Mladenoff, D.J., T.A. Sickley, R.G. Haight, and A.P. Wydeven. 1995. A regional landscape analysis and prediction of favorable gray wolf habitat in the Northern Great Lakes region. Conservation Biology 9: 279-294.

Moore, T. 2007. [unpublished draft]. National Forest System Road Trends, Trends Analysis Submitted to Office of Management and Budget. United States Department of Agriculture, Forest Service, Engineering Staff, Washington Office, Washington, DC.

National Fish, Wildlife and Plants Climate Adaptation Partnership (NFWPCAP). 2012. National Fish, Wildlife and Plants Climate Adaptation Strategy. Association of Fish and Wildlife Agencies, Council on environmental Quality, Great Lakes Indian Fish and Wildlife Commission, National Oceanic and Atmospheric Administration, and U.S. Fish and Wildlife Service. Washington, DC.

Noss, R.F. 2001. Beyond Kyoto: forest management in a time of rapid climate change. Conservation Biology 15(3): 578-590.

Ortega, Y.K., and D.E. Capen. 2002. Roads as edges: effects on birds in forested landscapes. Forest Science 48(2): 381–396.

Ouren, D.S., C. Haas, C.P. Melcher, S.C. Stewart, P.D. Ponds, N.R. Sexton, L. Burris, T. Fancher, and Z.H. Bowen. 2007. Environmental effects of off-highway vehicles on Bureau of Land Management lands: A literature synthesis, annotated bibliographies, extensive bibliographies, and internet resources: U.S. Geological Survey, Open-File Report 2007-1353, 225 p.

Parmesan, C. 2006. Ecological and evolutionary responses to recent climate change. Annual Review of Ecology, Evolution, and Systematics 37: 637-669.

Quigley, T.M., and S.J. Arbelbide, tech. eds. 1997. An assessment of ecosystem components in the interior Columbia basin and portions of the Klamath and Great Basins: volume 1 and volume 3. Gen. Tech. Rep. PNW-GTR-405. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Available at: http://www.fs.fed.us/pnw/publications/pnw_gtr405/.

Reynolds, K. 1999. Netweaver for EMDS user guide (version1.1); a knowledge base development system. General technical Report PNW-GTR-471. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.

Rhodes, J.J., McCullough, D.A., and F.A. Espinosa. 1994. A coarse screening process for evaluation of the effects of land management activities on salmon spawning and rearing habitat in ESA consultations. Tech. Rep. 94-4. Portland, OR: Columbia River Intertribal Fish Commission. 127 p.

Rieman, B., D. Lee, G. Chandler, and D. Myers. 1997. Does wildfire threaten extinction for salmonids? Responses of Redband Trout and Bull Trout Following Recent Large Fires on the Boise National Forest, in Greenlee, J. M., Proceedings: First Conference on Fire Effects on Rare and Endangered Species and Habitats. Coeur d'Alene, Idaho. International Association of Wildland Fire. Fairfield, WA. p. 47-57.

Robichaud, P.R., L.H. MacDonald, and R.B. Foltz. 2010. Fuel management and Erosion. In: Cumulative Watershed Effects of Fuels Management in the Western United States. USDA Forest Service RMRS-GTR-231. P. 79-100. Available at: http://www.fs.fed.us/rm/pubs/rmrs_gtr231/rmrs_gtr231_079_100.pdf

Robinson, C., P.N. Duinker, and K.F. Beazley. 2010. A conceptual framework for understanding, assessing, and mitigation effects for forest roads. Environmental Review 18: 61-86.

Rooney, T.P. 2006. Distribution of ecologically-invasive plants along off-road vehicle trails in the Chequamegon National Forest, Wisconsin. The Michigan Botanist 44:178-182

Rost, G.R., and J.A. Bailey. 1979. Distribution of mule deer and elk in relation to roads. Journal of Wildlife Management 43(3): 634–641.

Rowland, M.M., M.J. Wisdom, B.K. Johnson, and M.A. Penninger. 2005. Effects of roads on elk: implications for management in forested ecosystems. Pages 42-52. IN: Wisdom, M.J., technical editor, The Starkey Project: a Synthesis of Long-term Studies of Elk and Mule Deer. Reprinted from the 2004 Transactions of the North American Wildlife and Natural Resources Conference, Alliance Communications Group, Lawrence, KS.

Schiffman, L. 2005. Archaeology, Off-Road Vehicles, and the BLM. Published online April 20, 2005. Archeaology.
Available at: http://www.archaeology.org/online/features/southwest/

Semlitsch, R.D., T.J. Ryan, K. Hamed, M. Chatfield, B. Brehman, N. Pekarek, M. Spath, and A. Watland. 2007. Salamander abundance along road edges and within abandoned logging roads in Appalachian forests. Conservation Biology 21: 159-167.

Shilling, F., J. Boggs, and S. Reed. 2012. Recreational System Optimization to Reduce Conflict on Public Lands. Environmental Management 50: 381–395.

Strittholt, J., and D. Dellasala. 2001. Importance of Roadless Area Conservation in Forested Ecosystems: Case Study of the Klamath-Siskiyou Region of the United States. In Conservation Biology 15(6): 1742-1754.

Switalski, T.A., J.A. Bissonette, T.H. DeLuca, C.H. Luce, and M.A. Madej. 2004. Benefits and impacts of road removal. Frontiers in Ecology and the Environment. 2(1): 21-28.
Available at: http://www.fs.fed.us/rm/pubs_other/rmrs_2004_switalski_t001.pdf

Switalski, T.A., and C.R. Nelson. 2011. Efficacy of road removal for restoring wildlife habitat: black bear in the Northern Rocky Mountains, USA. Biological Conservation 144: 2666-2673.

Switalski, T.A., and A. Jones. 2012. Off-road vehicle best management practices for forestlands: A review of scientific literature and guidance for managers. Journal of Conservation Planning 8: 12-24.

The Wilderness Society. 2004. Landscape Connectivity: An Essential Element of Land Management. Policy Brief. Number 1.

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

Thiel, R.P. 1985. The relationships between road densities and wolf habitat in Wisconsin. American Midland Naturalist 113: 404-407.

Trombulak S., and C. Frissell. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. Conservation Biology 14(1): 18-30.

USDA Forest Service. 1996a. National Forest Fire Report, 1994. Washington DC.

USDA Forest Service. 1996b. Status of the interior Columbia basin: summary of scientific findings. Gen. Tech. Rep. PNW-GTR-385. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station; U.S. Department of the Interior, Bureau of Land Management. 144 p.

USDA Forest Service. 1998. 1991-1997 Wildland Fire Statistics. Fire and Aviation Management, Washington, D.C.

USDA Forest Service. 1999. Roads Analysis: Informing Decisions about Managing the National Forest Transportation System. Misc. Rep. FS-643. Washington, D.C.: USDA Forest Service. 222 p. Available at: http://www.fs.fed.us/eng/road_mgt/DOCSroad-analysis.shtml

USDA Forest Service. 2001a. Final National Forest System Road Management Strategy Environmental Assessment and Civil Rights Impact Analysis. U.S. Department of Agriculture Forest Service Washington Office, January 2001.

USDA Forest Service. 2010. Water, Climate Change, and Forests: Watershed Stewardship for a Changing Climate, PNW-GTR-812, June 2010, 72 p. Available at: http://www.fs.fed.us/pnw/pubs/pnw_gtr812.pdf.

USDA Forest Service. 2011a. Adapting to Climate Change at Olympic National Forest and Olympic National Park. Forest Service Pacific Northwest Research Station General Technical Report, PNW-GTR-844, August 2011. Available at: http://www.fs.fed.us/pnw/pubs/pnw_gtr844.pdf

USDA Forest Service. 2011b. National Roadmap for Responding to Climate Change. US Department of Agriculture. FS-957b. 26 p. Available at: http://www.fs.fed.us/climatechange/pdf/Roadmap_pub.pdf.

USDA Forest Service. 2012a. Assessing the Vulnerability of Watersheds to Climate Change: Results of National Forest Watershed Vulnerability Pilot Assessments. Climate Change Resource Center.

USDA Forest Service. 2012b. National Best Management Practices for Water Quality Management on National Forest System Lands. Report# FS-990. 177p. Available at:

http://www.fs.fed.us/biology/resources/pubs/watershed/FS_National_Core_BMPs_April2012.pdf

USDI Fish and Wildlife Service. 1993. Grizzly bear recovery plan. Missoula, MT. 181p.

USDI Fish and Wildlife Service. 1999. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for Bull Trout in the Coterminous United States; Final Rule. Federal Register Volume 64, Number 210 (Monday, November 1, 1999). p. 58922.

USDI Bureau of Land Management. 2000. Strategic paper on cultural resources at risk. Bureau of Land Management, Washington, D.C. 18 p.

USDI National Park Service. 2010. Climate Change Response Strategy. National Park Service Climate Change Response Program, Fort Collins, Colorado. Available at: http://www.nature.nps.gov/climatechange/docs/NPS_CCRS.pdf.

van Dyke, F.G., R.H. Brocke, H.G. Shaw, B.B Ackerman, T.P. Hemker, and F.G. Lindzey. 1986. Reactions of mountain lions to logging and human activity. Journal of Wildlife Management. 50(1): 95–102.

Wasser, S.K., K. Bevis, G. King, and E. Hanson. 1997. Noninvasive physiological measures of disturbance in the northern spotted owl. Conservation Biology 11(4): 1019–1022.

Wemple, B.C., J.A. Jones, and G.E. Grant. 1996. Channel network extension by logging roads in two basins, western Cascades, OR. Water Resources Bulletin 32: 1195-1207.

Wemple, B.C., F.J. Swanson, and J.A. Jones. 2001. Forest Roads and geomorphic process interactions, Cascade Range, Oregon. Earth Surface Process and Landforms 26: 191-204. Available at: http://andrewsforest.oregonstate.edu/pubs/pdf/pub2731.pdf

Wilcove, D.S. 1990. The role of wilderness in protecting biodiversity. Natural Resources and Environmental Issues: Vol. 0, Article 7.

Wisdom, M.J., R.S. Holthausen, B.C. Wales, C.D. Hargis, V.A. Saab, D.C. Lee, W.J. Hann, T.D. Rich, M.M. Rowland, W.J. Murphy, and M.R. Eames. 2000. Source habitats for terrestrial vertebrates of focus in the interior Columbia basin: Broad-scale trends and management implications. Volume 1 – Overview. Gen. Tech. Rep. PNW-GTR-485. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.
Wydeven, A.P, D.J. Mladenoff, T.A. Sickley, B.E. Kohn, R.P. Thiel, and J.L. Hansen. 2001. Road density as a factor in habitat selection by wolves and other carnivores in the Great Lakes Region. Endangered Species Update 18(4): 110-114.

Attachments

Attachment 1: Wildfire and Roads Fact Sheet

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

ATTACHMENT A

THE WILDERNESS SOCIETY

Roads and Fire: A Proven Relationship

Photo: Lou Anegli Digital

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. (DellaSala, 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)

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Human Activity and Wildfire

- Sparks from cars, off-road vehicles, and neglected campfires caused nearly 50,000 wildfire ignitions 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 area (USDA 2000, Table 3-19).

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

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ATTACHMENT A

Roads and Fire: A Proven Relationship

Photo: USDA Forest Service, Coconino National Forest

References

Arienti, M. Cecilia; Cumming, Steven G., et al. 2009. Road network density correlated with increased lightning fire incidence in the Canadian western boreal forest. International Journal of Wildland Fire 2009, 18, 970–982

DellaSala, D.A., D.M. Olson and S.L. Crane. 1995. Ecosystem management and biodiversity conservation: Applications to in-landPacific Northwest forests. Pp. 139-160 in: R.L. Everett and D.M. Baumgartner, eds. Symposium Proceedings: Ecosystem Management inWestern Interior Forests. May 3-5, 1994, Spokane, WA. Washington State University Cooperative Extension, Pullman, WA.

Hann, W.J., et al. 1997. An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins: Volume II, Ch. 3, p. 882

Romer-Calcerrada, Raul. 2008. GIS analysis of spatial patterns of human-caused wildfire ignoition risk in the SW of Madrid (Central Spain). Landscape Ecol. 23:341-354.

Sierra Nevada Ecosystem Project. 1996. Status of the Sierra Nevada: Sierra Nevada Ecosystem Project, Final Report to Con-gress Volume I: Assessment summaries and management strategies. Wildland Resources Center Report No. 37. Center for Water and Wildland Resources, Unversity of California, Davis, CA.

USDA Forest Service. 1996. National Forest Fire Report 1994.Washington, D.C.

USDA Forest Service. 1998. 1991-1997 Wildland fire statistics. Fire and Aviation Management, Washington, D.C.

USDA. 2000. Forest Service Roadless Area Conservation Rule Final Environmental Impact Statement, Ch. 3,.

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.[1] 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.[2] 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 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

[1] 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.

[2] 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.

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,[3] 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).

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

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

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 [4]

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 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).

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

Wildlife Resources [5]

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.

- 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

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

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.ecosystem-management.org/48536_FSPLT1_009720.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/mi² 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

References

Anderson, D.E., O.J. Rongstad, and W.R. Mytton. 1990. Home range changes in raptors exposed to increased human activity levels in southeastern Colorado. Wildlife Bulletin 18:134-142.

Ayala, R.D., P. Srivastava, C.J. Brodbeck, E.A. Carter, and T.P. McDonald. 2005. Modeling Sediment Transport from an Off-Road Vehicle Trail Stream Crossing Using WEPP Model. American Society of Agricultural and Biological Engineers, 2005 ASAE Annual International Meeting, Paper No: 052017.

Belnap, J. 1993. Recovery rates of cryptobiotic crusts: inoculant use and assessment methods. Great Basin Naturalist 53:89-95.

Belnap, J. and D.A. Gillette. 1997. Disturbance of biological soil crusts: impacts on potential wind erodibility of sandy desert soils in SE Utah. Land Degradation and Development 8: 355-362.

Brattstrom, B.H., and M.C. Bondello. 1979. The effects of dune buggy sounds on the telencephalic auditory evoke response in the Mojave fringe-toed lizard, Uma scoparia. Unpublished report to the U.S. Bureau of Land Management, California Desert Program, Riverside, CA. 31p.

Chin, A., D.M. Rohrer, D.A. Marion, and J.A. Clingenpeel. 2004. Effects of all terrain vehicles on stream dynamics. Pages:292-296 in Guldin, J.M. technical compiler, Ovachita and Ozark Mountains Symposium: ecosystem management research. General technical report SRS-74. Ashville, NC: USDA, FS, Southern Research Station.

Davidson, D.W, W.D. Newmark, J.W. Sites, D.K. Shiozawa, E.A. Rickart, K.T. Harper, and R.B. Keiter. 1996. Selecting Wilderness areas to conserve Utah's biological diversity. Great Basin Naturalist 56: 95-118.

Dregne, H.E. 1983. Physical effects of off-road vehicle use. Pages 15-30 in R.H. Webb and H.G. Wilshire. Environmental Effects of Off-Road Vehicles: Impacts and Management in Arid Regions. Springer-Verlag, New York.

Foltz, R.B. 2006. Erosion from all terrain vehicle (ATV) trails on National Forest lands. The American Society of Agricultural and Biological engineers (ASABE). Paper# 068012. St. Joseph, MI.

Frueh, LM. 2001. Status and Summary Report on OHV Responsible Riding Campaign. Prepared by Monaghan and Associates for the Colorado Coalition for Responsible OHV Riding. Available at http://www.wildlandscpr.org/files/CO%20OHV%20Focus%20Group%20StatusSummaryReport_1.pdf.

Gucinski, H., M. J. Furniss, R. R. Ziemer, and M. H. Brookes. 2001. Forest roads: a synthesis of scientific information. Gen. Tech. Rep. PNWGTR-509. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR. http://www.fs.fed.us/pnw/pubs/gtr509.pdf

Hamann, B., H. Johnston, P. McClelland, S. Johnson, L. Kelly, and J. Gobielle. 1999. Birds. Pages 3.1-3.34 in Joslin, G. and H. Youmans, coordinators Effects of Recreation on Rocky Mountain Wildlife: A Review for Montana.

Hershey, T.J., and T.A. Leege. 1982. Elk movements and habitat use on a managed forest in north-central Idaho. Idaho Department of Fish and Game. 32p.

Hinckley, B.S., Iverson, R.M. and B. Hallet. 1983. Accelerated water erosion in ORV-use areas. Pages 81-96 in Webb, R.H. and H.G. Wilshire, editors, Environmental Effects of Off-Road Vehicles. Springer-Verlag, New York.

Irwin, L.L., and J.M. Peek. 1979. Relationship between road closure and elk behavior in northern Idaho. Pages 199-205 in Boyce, M.S. and L.D. Hayden-Wing, editors, North American Elk: Ecology, Behavior, and Management. Laramie, WY: University of Wyoming.

Iverson, R.M., Hinckley, B.S., and R.H. Webb. 1981. Physical effects of vehicular disturbance on arid landscapes. Science 212: 915-917.

Janis, M.W., and J.D. Clark. 2002. Responses of Florida panthers to recreational deer and hog hunting. Journal of Wildlife Management 66(3): 839-848.

Lewis, M.S., and R. Paige. 2006. Selected Results From a 2006 Survey of Registered Off-Highway Vehicle (OHV) Owners in Montana. Responsive Management Unit Research Summary No. 21. Prepared for Montana Fish, Wildlife and Parks. http://fwp.mt.gov/content/getItem.aspx?id=19238

Millspaugh, J.J. 1995. Seasonal movements, habitat use patterns and the effects of human disturbances on elk in Custer State Park, South Dakota. M.S. Thesis. Brookings, SD: South Dakota State University.

Millspaugh, J.J., G.C. Brundige, R.A. Gitzen, and K.J. Raedeke. 2000. Elk and hunter space-use sharing in South Dakota. Journal of Wildlife Management 64(4): 994-1003.

Millspaugh, J.J., Woods, R.J. and K.E. Hunt. 2001. Fecal glucocorticoid assays and the physiological stress response in elk. Wildlife Society Bulletin 29: 899-907.

Misak, R.F., J.M. Al Awadhi, S.A. Omar, and S.A. Shahid. 2002. Soil degradation in Kabad area, southwestern Kuwait City. Land Degradation & Development. 13(5): 403-415.

Nakata, J.K., H.G. Wilshire, and G.G. Barnes. 1976. Origin of Mojave Desert dust plumes photographed from space. Geology 4(11): 644-648.

Nash, R.F., G.G. Gallup, jr., and M.K. McClure. 1970. The immobility reaction in leopard frogs (Rana pipiens) as a function of noise induced fear. Psychonometric Science 21(3): 155-156.

Ouren, D.S., Haas, Christopher, Melcher, C.P., Stewart, S.C., Ponds, P.D., Sexton, N.R., Burris, Lucy, Fancher, Tammy, and Bowen, Z.H., 2007, Environmental effects of off-highway vehicles on Bureau of Land Management lands: A literature synthesis, annotated bibliographies, extensive bibliographies, and internet resources: U.S. Geological Survey, Open-File Report 2007-1353, 225 p.

Pacific Rivers Council. 2010. Roads and Rivers 2: An Assessment of National Forest Roads Analyses. Portland, OR http://pacificrivers.org/science-research/resources-publications/roads-and-rivers-ii/download

Pacific Watershed Associates. 2005. Erosion Assessment and Erosion Prevention Planning Project for Forest Roads in the Biscuit Fire Area, Southern Oregon. Prepared for Pacific Rivers Council and The Siskiyou Project. Pacific Watershed Associates, Arcata, California. http://pacificrivers.org/files/post-fire-management-and-sound-science/Final%20Biscuit%20PWA%20Report.pdf

Phillips, G.E. 1998. Effects of human-induced disturbance during calving season on reproductive success of elk in the upper Eagle River Valley. Dissertation. Fort Collins, CO: Colorado State University.

Preisler, H.K., A.A. Ager, and M.J. Wisdom. 2006. Statistical methods for analyzing responses of wildlife to human disturbance. Journal of Applied Ecology 43: 164-172.

Rowland, M.M., M.J. Wisdom, B.K. Johnson, and M.A. Penninger. 2005. Effects of roads on elk: implications for management in forested ecosystems. Pages 42-52. IN: Wisdom, M.J., technical editor, The Starkey Project: a Synthesis of Long-term Studies of Elk and Mule Deer. Reprinted from the 2004 Transactions of the North American Wildlife and Natural Resources Conference, Alliance Communications Group, Lawrence, KS.

Sack, D., and S. da Luz, Jr. 2003. Sediment Flux and Compaction Trends on Off-Road Vehicle (ORV) and other Trails in an Appalachian Forest Setting. Physical Geography 24 (6): 536-554.

Snyder, C.T., D.G. Frickel, R.E. Hadley, and R.F. Miller. 1976. Effects of off-road vehicle use on the hydrology and landscape of arid environments in central and southern California. U.S. Geological Survey Water-Resources Investigations Report #76-99. 45p.

Switalski, T. A. and A. Jones. 2012. Off-road Vehicle Best Management Practices for Forestlands: A Review of Scientific Literature and Guidance for Managers. Journal of Conservation Planning. Vol. 8 (2014). Pages 12 – 24.

USFWS, Nevada Fish and Wildlife Office. 2007. 12-Month Finding on a Petition to List the Sand Mountain Blue Butterfly (Euphilotes pallescens ssp. arenamontana) as Threatened or Endangered with Critical Habitat. Federal Register, Vol. 72, No. 84. See pages 24260-61. http://www.wildlandscpr.org/denial-petition-list-sand-mountain-blue-butt....

USDA Forest Service (USFS) 1994. Rio Grande National Forest Roads Analysis Process Report. See pages 76-77 and 118.

USDA Forest Service. (USFS) 1998. National Forest System Roads and Use. Available online at http://www.fs.fed.us/eng/road_mgt/roadsummary.pdf.

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

Vollmer, A.T., B.G. Maza, P.A. Medica, F.B. Turner, and S.A. Bamberg. 1976. The impact of off-road vehicles on a desert ecosystem. Environmental Management 1(2):115-129.

Webb, R.H., Ragland, H.C., Godwin, W.H., and D. Jenkins. 1978. Environmental effects of soil property changes with off-road vehicle use. Environmental Management 2: 219-233.

Webb, R.H.. 1983. Compaction of desert soils by off-road vehicles. Pages 51-79 in: Webb, R.H. and Wilshire, H.G., editors, Environmental Effects of Off-Road Vehicles. Springer-Verlag, New York.

Welsh, M.J., L.H. MacDonald, and E. Brown, and Z. Libohova. 2006. Erosion and sediment delivery from unpaved roads and off-highway vehicles (OHV). Presented at AGU fall meeting. San Francisco, CA.

Wilshire, H.G., G.B. Bodman, D. Broberg, W.J. Kockelman, J. Major, H.E. Malde, C.T. Snyder, and R.C. Stebbins. 1977. Impacts and management of off-road vehicles. The Geological Society of America. Report of the Committee on Environment and Public Policy.

Wilshire, H.G., Nakata, J.K., Shipley, S., and K. Prestegaard. 1978. Impacts of vehicles on natural terrain at seven sites in the San Francisco Bay area. Environmental Geology 2: 295-319.

Wilshire, H.G. 1980. Human causes of accelerated wind erosion in California's deserts. Pages 415-433 in D.R. Coates and J.B. Vitek, editors, Thresholds in Geomorphology. George Allen & Unwin, Ltd., London.

Wilshire, H.G. 1992. The wheeled locusts. Wild Earth 2: 27-31.

Wisdom, M.J., R.S. Holthausen, B.C. Wales, C.D. Hargis, V.A. Saab, D.C. Lee, W.J. Hann, T.D. Rich, M.M. Rowland, W.J. Murphy, and M.R. Eames. 2000. Source habitats for terrestrial vertebrates of focus in the interior Columbia basin: Broad-scale trends and management implications. Volume 1 – Overview. Gen. Tech. Rep. PNW-GTR-485. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. http://www.fs.fed.us/pnw/pubs/gtr485/gtr485vl.pdf

Wisdom, M.J., H.K. Preisler, N.J. Cimon, and B.K. Johnson. 2004. Effects of off-road recreation on mule deer and elk. Transactions of the North American Wildlife and Natural Resource Conference 69.

Wisdom, M.J. 2007. Shift in Spatial Distribution of Elk Away from Trails Used by All-Terrain Vehicles. Report 1, May 2007, USDA Forest Service, Pacific Northwest Research Station, La Grande, OR.

ATTACHMENT B

Keith Hammer <keith@swanview.org> November 15, 2018 3:43 PM
To: Luke Lamar <Luke@svconnections.org>, "swcc-participants@googlegroups.com" <swcc-participants@googlegroups.com>
Cc: Cory Davis <cory.davis@umontana.edu>
Re: [SWCC] Mid-Swan project field trip Nov 16

Luke;

Thanks for this clarification. I hadn't read about this mischaracterization of SWCC's role by Supervisor Weber in any of the media reports.

Perhaps the SWCC should make the media aware of how and to what extent SWCC was and wasn't involved in this proposal?

Otherwise, the public can't help but think that the SWCC helped craft this proposal and is hence in large part responsible for it.

I hate to think how many people might write in in support of the Mid-Swan proposal because they believe in collaborative solutions and think that the proposal has already passed muster with the SWCC so it must be A-OK.

Swan View and many others have already asked for an extension in the public comment period for Mid-Swan, based on the extensive scoping materials, maps and geographic scale.

Perhaps the SWCC should ask for an extension as well so that it can get this matter cleared up publicly well in advance of comments coming due.

Keith

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"Nature and human nature on the same path."

On Nov 15, 2018, at 2:48 PM, Luke Lamar <Luke@svconnections.org> wrote:

> Keith, thanks for sharing your thoughts with the group. As a point of clarification, the SWCC provided constructive criticism and feedback to the Mid-Swan team as *they* developed this proposal. The topic of new, permanent roads was never discussed between the SWCC and the Mid-Swan team at any of our meetings. Unfortunately, Chip Weber used some very poorly chosen words when he described the SWCC's involvement as "crafting/developing" this proposal in recent print media. Many members of the collaborative were just as surprised as you about the new, permanent road additions in the proposal and is just one of many topics the SWCC will address in our comments.
>
> Thanks,
>
> On Thu, Nov 15, 2018 at 10:58 AM Keith Hammer <keith@swanview.org> wrote:
>
>> Cory et al;
>>
>> I can't make the field trip tomorrow due to a previously scheduled engagement.
>>
>> I hope you'll all take a look at Map 1, in addition to Maps 12 and 13, to put this Mid-Swan proposal into context with the unsustainable road system that already exists in the Swan.
>>
>> Many of us supported the acquisition of Plum Creek lands in part to see those lands managed better as public lands than Plum Creek did.
>>
>> Instead, this Mid-Swan project proposes to build another 60 miles of road, which will make many previously unroaded areas look like former over-roaded Plum Creek lands. For the Forest Service to follow Plum Creek's industrial model by building roads into many of the last unroaded pockets of forest, while trying to call it "landscape restoration," is like putting lipstick on a pig.
>>
>> It is also worth noting that some of these new roads would be built across avalanche chutes or rebuilt across avalanche chutes where the Forest Service has already had problems with culverts plugging up with avalanche debris. In some cases those roads have been reclaimed by removing the culverts (such as in Goat Creek and North Lost Creek). You can see a photo of one such plugged culvert, which finally got removed this summer, at:
>> http://www.mtpr.org/post/flathead-forest-proposes-70000-acre-restoration-resilience-project
>>
>> These new roads are simply too high a cost to pay for the "active management" you may have in mind and be supportive of. Building new roads while simply "storing" or "stormproofing" roads also does not comply with the current Forest Plan, nor will the pending revised Forest Plan maintain grizzly bear habitat security conditions that existed in 2011 as promised - due in large part to the switch from requiring that roads be reclaimed and decommissioned to allowing them to be simply "stored." The main part of our Forest Plan Objection summarizes this in just 12 pages, at:
>> http://www.swanview.org/reports/SVC_Forest_Plan_Objection.pdf
>>
>> Our Roads to Ruin Report and its various supplements go into greater detail at:
>> http://www.swanview.org/articles/whats-new/supplement_issued_to_roads_to_ruin_report/248
>>
>> I hope you'll keep these thoughts in mind during tomorrow's field tour and during further discussions about the Mid-Swan Project. We are very disappointed to see this Project proposed as "landscape restoration," let alone as having been developed by the SWCC.
>>
>> Thanks,
>>
>> Keith
>>
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>>
>> "Nature and human nature on the same path."
>>
>> On Nov 14, 2018, at 12:06 PM, "Davis, Cory" <cory.davis@umontana.edu> wrote:

ATTACHMENT B

Hi All,

Here is a little more detail for the Mid-Swan Landscape Project field trip hosted by Swan Valley Connections this Friday. We'll meet at SVC (6887 MT Hwy 83, Condon) at 10am and return about 2pm. We'll be visiting areas in the WUI boundary near the "B-2" label on Maps 12 & 13 in the Scoping Document. There are several issues that we can discuss in this area. Members of the Forest Service Mid-Swan team will be on hand to answer questions and take part in the discussion. Bring bear spray, blaze orange, warm clothes, lunch, and your questions. Thank you to the folks at SVC for hosting and planning this field trip!

Link to scoping document: https://www.fs.usda.gov/project/?project=54853

Thank you,

Cory

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SwanValleyConnections.org
A Confluence of Conservation and Learning

"Impassable" Roads Not in TMRD | Extracted from Flathead N.F. Data | ATTACHMENT C | CORRECTED 8/29/18

FID	RD ID	NAME	BMP	EMP	LENGTH	InvNotes	StrmAli
0	10753	LOWER WOLF	1.5	3	1.5	WEPP survey completed as part of Crystal Cedar, multiple landslides	YES
1	1670A	DRY KNOB A	0	0.5	0.5	Panel group 2, no stream aligned cmps remain	no
2	11024	JIMMIE RIDGE	0.06	0.85	0.788	2008 cmp monitoring	no
3	10919	UPPER CANYON	0	0.1	0.1	unable to locate prism, likely obliterated	no
4	895B	LOST JOHNNY	5.38	5.5	0.125	no stream aligned cmp	no
5	9716	LOWER STOPHER	0	2.84	2.84	poorly aligned and undersized cmp in Stopher Creek inventoried in 2017	yes
6	9716B	STOPHER GOFOR	0	0.82	0.82	one stream aligned cmp on ephemeral stream with partially blocked inlet and crushed outlet	yes
7	5246	YEW FLATS	0	0.4	0.4	no stream aligned cmps	no
8	9503	ANNA CREEK	1.3	1.87	0.57	no stream aligned cmps	no
9	1650	LINDGERGH BLOWDOWI	0	0.4	0.4	no stream aligned cmp	no
10	549L	BUNKER CREEK L	0	0.7	0.7	Inventoried as part of BAER assessment	no
11	5279	COAL DUST ONE	0	1.72	1.72	Panel Group 2 5 stream aligned cmps some with alignement issues. see cmp monitoring data	yes
12	10916	DEEP HELL	0	0.2	0.2	Panel group 2, no stream aligned cmps remain	no
13	568E	SPOTTED BEAR RIVER E	0	0.05	0.05	no stream aligned cmp	no
14	9831	OTILA BASIN	1.35	2	0.65	HH files	no
15	1684	COAL CREEK CONNECTO	6.9	7.5	0.6	Panel Group 2, 2 stream aligned cmps. see survey point data for more information	yes
16	11024	JIMMIE RIDGE	0.85	2	1.15	2008 cmp monitoring	no
17	2820X	MIDDLE FORK X	0	0.2	0.2	no inv. call based on hs character and obs of rd 2820	no
18	549Q	BUNKER CREEK Q	0	0.2	0.2		no
19	10802	RAGHORN	0	3.69	3.69	Panel Group 2, culverts to be removed in 2017	yes
20	895L	WEST SIDE SOUTH FORK	0	0.8	0.8	2008 cmp monitoring	no
21	2801Y	CONNOR Y	0	1.1	1.1	not inventoried due to safety and logistics 2017	
22	1675A	MAHONEY	0	0.17	0.17	one stream aligned cmp near end of road	yes
23	549S	BUNKER CREEK S	0	0.9	0.9		no
24	10753	LOWER WOLF	0	1.5	1.5	WEPP surveys compl as part of Crystal Cedar, landslide	YES
25	1636A	PETERS CREEK	0	0.45	0.451	no stream aligned cmps	no
26	9799	CZAR CREEK ONE	0	0.48	0.484	no stream aligned cmp	no
27	2860	LOST JOHNNY RIDGE	0	4.8	4.8	multiple stream aligned cmps and water on road	yes
28	2820Z	MIDDLE FORK Z	0	0.3	0.3	no stream aligned cmps	no
29	1670B	DRY KNOB B	0	0.2	0.2	Panel group 2, no stream aligned cmps remain	no
30	5251B	GRAVES POINT B	0	0.45	0.45	no stream aligned cmp	no
31	5307A	SOUTH SIDE WHALE CRE	0	0.4	0.4	Panel Group 1	no
32	90195	MEADOW 1	0	0.94	0.943	no stream aligned cmp	no
33	11495	QUINTONKON CORRALS	0	0.06	0.06	no stream aligned cmp	no
34	549P	BUNKER CREEK P	0	0.4	0.4		no

Highlighting Roads Found to Have Stream-Aligned Culverts | By Keith Hammer 8/29/18

FID	RD ID	NAME	BMP	EMP	LENGTH	InvNotes	StrmAli
35	5317A	SPRING MEADOW BASIN	0	0.2	0.2	no stream aligned cmps	no
36	10818	DEEP HELLROARING CRE	2.15	2.3	0.15	panel group 2	no
37	2820A	LATE CREEK	0	0.7	0.7		no
38	5234	CENTER MOUNTAIN MO	0	1.8	1.8	non priority BT watershed but to be completed with Panel Group 1	no
39	5277	COAL DUST TWO	2.3	3.67	1.37	Panel Group 2, no remaining stream alilgned cmps	no
40	9792	ELK SIDEHILL	0	0.8	0.8	one stream aligned cmp with flow around pipe.	yes
41	9693	SOUTH KNIEFF	0	0.25	0.25	no stream aligned cmps	no
42	2801	SOUTH FORK CONNOR	2.74	3.6	0.86	no stream aligned cmp	no
43	9698	UPPER PEARL	0	0.44	0.44	hh files if decomed	no
44	549N	BUNKER CREEK N	0	0.2	0.2	Inventoried as part of BAER assessment	no
45	90196	MEADOW 2	0	0.35	0.35	no stream aligned cmp	no
46	1670C	DRY KNOB C	0	0.1	0.1	Panel group 2, no stream aligned cmps remain	no
47	9716	LOWER STOPHER	2.84	3.1	0.26	wepp inventory from 2015 Bug Creek field work	yes
48	70722	(DSL) MORAN JEEP ROAI	2.09	2.4	0.31	non BT priority watershed but completed with Panel Group 1	no
49	648D	BIG CREEK D	0	0.5	0.5	Panel group 2, no stream aligned cmps remain	no
50	568D	SPOTTED BEAR RIVER D	0	0.06	0.06	no stream aligned cmp	no
51	9767A	RIVER BEND	0.99	1.6	0.61	3 ditch relief cmps	no
52	2820Y	MIDDLE FORK Y	0	1.5	1.5	no stream aligned cmps	no
53	2817C	DOE CREEK CLAYTON CR	0	0.6	0.6	no stream aligned cmps, ditch relief cmps functioning in place	no
54	5275	WEST DEPUY CREEK	0	0.37	0.37	Panel group 2, no stream aligned cmps remain	no
55	549R	BUNKER CREEK R	0	0.6	0.6		no
56	5271C	DEPUY CREEK CONNECT(	0	1.1	1.1	2 strm aligned with significant ditch water, one cmp is only 18"	yes
57	10626	NORTH FORK PARKER	0	1.95	1.95	stream aligned cmps ruled out with inventory associated with Bug Creek WEPP	no
58	317	COAL CREEK HALLOWAT	16.2	18.5	2.32	Panel Group 2, 1 strm aligned cmp bottomless arch fully functional	yes
59	11497	UNCLE SMILEY	0	0.07	0.07	no stream aligned cmp	no
60	2820U	MIDDLE FORK U	0	1.6	1.6		no
61	90962	SV 4	0.27	0.3	0.028	no stream aligned cmp marc ruby inventory	no
62	1675	HAWK CREEK	0	0.75	0.75	non priority BT watershed but completed with Panel Group 1	no
63	5251B	GRAVES POINT B	0.45	1.28	0.833	no stream aligned cmp	no
64	9694	UPPER SOUTH KNIEFF	0	0.22	0.22	HH files	no
65	10754	UPPER WOLF	0	3.07	3.068	WEPP comp as part of Crystal Cedar, landslides, heavily vegetated	YES
66	2820W	MIDDLE FORK W	0	0.6	0.6	no inv. call based on hs character and obs of rd 2820	no
67	2820V	MIDDLE FORK V	0	0.8	0.8	no inv. call based on hs character and obs of rd 2820	no
68	549M	BUNKER CREEK M	0	0.7	0.7	Inventoried as part of BAER assessment	no
69	1604	SOUTH COAL RIDGE	0.7	2.7	2	Panel Group 2, 2 stream aligned cmps. see survey point data for more information	YES

FID	RD ID	NAME	BMP	EMP	LENGTH	InvNotes	StrmAli
70	10818	DEEP HELLROARING CRE	0	2.15	2.15	Panel group 2, no stream aligned cmps remain	no
71	5277A	COAL DUST TWO A	0	0.28	0.28	Panel Group 2, no remaining stream aligned cmps	no
72	5277	COAL DUST TWO	1.92	2.3	0.38	Panel Group 2, ditch relief cmp not stream aligned	no
73	10802	RAGHORN	0	3.69	3.69	Panel Group 2, Raghorn Road, all stream aligned cmps being removed in 2017	yes
74	1670	DRY KNOB	0	1.2	1.2	Panel group 2, no stream aligned cmps remain	no
75	9822	CZAR FLATS	0	0.92	0.915	no stream aligned cmp	no
76	9716	LOWER STOPHER	0	2.84	2.84	one stream aligned cmp	yes
77	9716B	STOPHER GOFOR	0	0.82	0.82	excavated stream crossing	no