July 10, 2019

James Melonas, Forest Supervisor
Hannah Bergemann, Fireshed Coordinator
Santa Fe National Forest Supervisor's Office
11 Forest Lane, Santa Fe, NM 87508

Re: Santa Fe Mountains Landscape Resiliency Project

Submitted via email to comments-southwestern-santafe@fs.fed.us and Hannah.Bergemann@usda.gov

Dear Supervisor Melonas and Fireshed Coordinator Bergemann,

This letter supplies the Center for Biological Diversity's ("the Center") comments on the Santa Fe Mountains Landscape Resiliency Project Scoping Document which was made available to the public on June 10, 2019. The scoping document specified that comments are due by Wednesday, July 10th 2019, making this letter timely.

The Center for Biological Diversity is a non-profit environmental organization with over 61,000 members, and 1.6 million activist-supporters nationwide who value wilderness, biodiversity, old growth forests, and the threatened and endangered species which occur on America's spectacular public lands and waters. Many of the Center's members and supporters frequently use and enjoy the spectacular landscapes of the Santa Fe National Forest landscape for recreation, sustenance, nature study, and spiritual renewal.

At the Center for Biological Diversity, we believe that the welfare of human beings is deeply linked to nature — to the existence in our world of a vast diversity of wild animals and plants. Because diversity has intrinsic value, and because its loss impoverishes society, we work to secure a future for all species, great and small, hovering on the brink of extinction. We do so through science, law and creative media, with a focus on protecting the lands, forests, waters and climate that species need to survive. The Center has and continues to actively advocate for increased protections for species and their habitats in New Mexico and across the American Southwest.

The Santa Fe Mountains Landscape Resiliency Project ("the Project") would encompass 50,566 acres in Española and Pecos/Las Vegas Ranger Districts of the Santa Fe National Forest in Santa Fe County and San Miguel County, New Mexico. The Center considers the proposed Project to contain some beneficial project elements insofar as restoration and fuels treatments in forests, shrublands, woodlands, and riparian areas are informed by the best available science and are coordinated within a cohesive and unified strategic, process-oriented approach.

These project elements have great potential to be positive management actions that should lead towards improved habitat, watershed function, and forest visitor experience. The scoping document seems to imply that a major focus of the project is to allow the use of fire, both planned and unplanned ignitions, to achieve restoration objectives. We strongly support this approach and are eager to continue work with the Santa Fe National Forest to develop a project that can harness the restorative benefits of fire in a way that compliments a variety of forest management goals and protects communities and other values at risk while not compromising habitats for threatened, endangered and sensitive wildlife species or the unique experience offered to the public in the beautiful forests of the Sangre de Cristo Mountains.

We are pleased that proposed Project includes the following components:

• Prescribed burning on up to 43,000 acres, exceeding the 21,557 acres of hand and mechanical tree removal (scoping document, p. 2).

• No mechanical equipment to be used on slopes greater than 40 percent (scoping document, p. 12).

• No new roads or temporary roads to be constructed (scoping document, pp.12, 13)

• Specification that mechanical and hand treatments will be "*noncommercial*" in nature (scoping document, pp. 2, 12, and 13).

• Thinning that would primarily target small diameter trees and medium diameter trees (up to 12 inches dbh) and no trees above 24 inches dbh would be cut (scoping document, p. 12); although in this letter we will address the need to implement a more refined approach to large tree retention.

• We support that "*noncommercial mechanical and hand-thinning treatments*" in the pinon-juniper type will be placed in "*strategic locations*" located "a*djacent to values at risk and in Wildland Urban Interface*." We appreciate that the overall objective to "*reduce the risk for large high-intensity wildfires*" (scoping document, p. 12; emphasis added) in the WUI, rather than to completely eliminate the risk of large high-intensity fires in the pinon juniper across the project area.

• "*Non-native species such as Siberian elm, Russian olive, salt cedar and Tree of Heaven would be cut and removed*" (scoping document, p. 14) as part of the 557 acres of riparian restoration; although in this letter we will address the need to implement diameter and age restrictions on conifer removal in riparian areas.

While the Center supports ecosystem-based management for resiliency outcomes, we must not forget that major landscape scale projects need to undergo a rigorous review under the National Environmental Policy Act (NEPA). NEPA is "*our basic national charter for protection of the environment*."[1] In enacting NEPA, Congress recognized the "*profound impact*" of human activities, including "*resource exploitation*," on the environment and declared a national policy

[1] *Center for Biological Diversity v. United States Forest Serv*., 349 F.3d 1157, 1166 (9th Cir. 2003) (quoting 40 C.F.R. § 1500.1).

"*to create and maintain conditions under which man and nature can exist in productive harmony.*"[2]

The statute has two fundamental two goals: *"(1) to ensure that the agency will have detailed information on significant environmental impacts when it makes decisions; and (2) to guarantee that this information will be available to a larger audience.*"[3] "*NEPA promotes its sweeping commitment to 'prevent or eliminate damage to the environment and biosphere' by focusing Government and public attention on the environmental effects of proposed agency action*."[4]

Stated more directly, NEPA's "'*action-forcing' procedures ... require the [Forest Service] to take a 'hard look' at environmental consequences*"[5] before the agency approves an action. "*By so focusing agency attention, NEPA ensures that the agency will not act on incomplete information, only to regret its decision after it is too late to correct*."[6] To ensure that the agency has taken the required "*hard look*," courts hold that the agency must utilize "*public comment and the best available scientific information.*"[7]

The Center will support the Project insofar as it meets the standards of NEPA, uses the best available scientific information, and provides for meaningful public participation from stakeholders of various perspectives, including the many local American citizens who are reluctant to support proposals that diminish the much beloved wild, wooded experience of the Sangre de Cristo Mountains remarkable forests.

These comments are divided into two sections. Section one presents Issues for Analysis. These are fundamental issues of concern that the Center asks are addressed and answered in detail in any subsequent NEPA document. We also would appreciate the opportunity to discuss these issues in person at a meeting or field trip.

Section two presents a reasonable alternative for analysis that will meet the project purpose of improving ecosystem resilience of a priority landscape to future disturbances including wildfire, climate change, and insect outbreaks. Section two provides extensive scientific citation to support our alternative which we request any subsequent NEPA document to address specifically and without cursory dismissal.

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[2] 42 U.S.C. § 4331(a).

[3] *Envtl. Prot. Info. Ctr. v. Blackwell*, 389 F. Supp. 2d 1174, 1184 (N.D. Cal. 2004) (quoting *Neighbors of Cuddy Mt. v. Alexander*, 303 F.3d 1059, 1063 (9th Cir. 2002)); *see also Earth Island v. United States Forest Serv.*, 351 F.3d 1291, 1300 (9th Cir. 2003) ("NEPA requires that a federal agency 'consider every significant aspect of the environmental impact of a proposed action ... [and] inform the public that it has indeed considered environmental concerns in its decision-making process.'").

[4] *Marsh v. Or. Natural Res. Council*, 490 U.S. 360, 371 (1989) (quoting 42 U.S.C. § 4321).

[5] *Metcalf v. Daley*, 214 F.3d 1135, 1141 (9th Cir. 2000) (quoting *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 348 (1989)).

[6] *Marsh*, 490 U.S. at 371 (citation omitted).

[7] *Biodiversity Cons. Alliance v. Jiron*, 762 F.3d 1036, 1086 (10th Cir. 2014) (internal citation omitted).

SECTION I. ISSUES FOR ANALYSIS

The scoping document is well prepared, well organized, and simple. It does lack detail on some very important issues however, although this is appropriate at this point in the Projects development. The Center has identified a number of issues for analysis in any subsequently prepared NEPA document. The agency's failure to respond to these comments violates NEPA.[8]

The center requests that the following issues are identified and analyzed in the EIS:

• ISSUE 1: Retention of existing old (>150 years) and large (>18" dbh) trees, and identification and retention of old growth patches and stands.

• ISSUE 2: Treatments in Mexican spotted owl habitat.

• ISSUE 3: Treatments for dwarf mistletoe.

• ISSUE 4: Effects of livestock grazing on meeting the Projects purpose and need.

• ISSUE 5: Conditions based management, monitoring, and adaptive management.

• ISSUE 6: Identification of and treatments in roadless and unroaded areas.

• ISSUE 7: Locally specific reference conditions are needed.

We will address each of these seven issues in detail below.

ISSUE 1: RETENTION OF EXISTING OLD (>150 YEARS) AND LARGE (>18" DBH) TREES, AND IDENTIFICATION AND RETENTION OF OLD GROWTH PATCHES AND STANDS.

In 2006, a team of dedicated professionals representing industry, conservation organizations, land management agencies, and independent scientists collaboratively developed a framework document called the New Mexico Forest Restoration Principles[9]. Among those authors was staff from the Center for Biological Diversity. We stand by the agreements established in this document when we signed our names alongside those in the US Forest Service, Bureau of Land Management, and other partners in restoration.

These principles for restoration should be used as guidelines for project development and they represent the "zone of agreement" where controversy, delays, appeals, and litigation are significantly reduced. They are appropriate for application to specific restoration projects in the southwestern United States, and especially the Santa Fe National Forest. Projects using these principles are driven primarily by ecological objectives while promoting economic and social

[8] *See* 40 C.F.R. 1503.4(a) ("An agency preparing a final environmental impact statement shall assess and consider comments both individually and collectively, and shall respond ... stating its response in the final statement.").

[9] Attached to this letter.

benefits. The Santa Fe Mountains Landscape Resiliency Project seems like a perfect fit for adopting these principles.

Slowly, forest restoration treatments have shifted from an almost exclusive focus on hand thinning of small diameter ladder fuels to what we see now in many so-called "restoration" projects: a return of widespread commercial logging of trees of nearly any size to move towards agency-established desired conditions. Thus far, the Santa Fe Mountains Landscape Resiliency Project does not appear to be one of those imposters.

Some of the eighteen Principles are especially important to the Center, especially those regarding retention of old and large trees. The New Mexico Forest Restoration Principles clearly state that restoration projects should "*preserve old or large trees while maintaining structural diversity and resilience*."

Large and old tree retention meets the project purpose and need

We believe that many forest restoration projects in the southwest are now generally moving in the wrong direction, with excessive emphasis on structural manipulation and insufficient attention to fire-driven ecological processes. Many so-called "restoration projects" such as the Luna Restoration Project on the Gila National Forest even cunningly devise ways to justify cutting old growth up to 180 years old and trees up to 24" (and even larger).

Until the Forest Service created GTR-310, large and old tree retention has been a fundamental principle of Southwestern forest restoration. Past timber management destroyed nearly all ponderosa pine and mixed conifer old growth forest in Arizona and New Mexico, including on much of the Santa Fe National Forest. Even-aged or simplified forest has replaced the complex forests of the pre-settlement southwestern landscape.[10,11]

Retention of large trees is fundamentally important to fire resistance of treated stands. [12] Mature conifers have a high capacity to survive and recover from crown scorch.[13] Large tree structure enhances forest resilience to severe fire effects[14,15,16] whereas removing them may undermine fire

[10] Covington, W.W., and M.M. Moore. 1994. Southwestern ponderosa forest structure: Changes since Euro-American settlement. *Journal of Forestry* 92: 39-47.

[11] Sesnie, S. and J. Bailey. 2003. Using history to plan the future of old-growth ponderosa pine. *Journal of Forestry* 99(7) (Oct/Nov): 40-47.

[12] DellaSala, D.A., J.E. Williams, C.D. Williams and J.F. Franklin. 2004. Beyond smoke and mirrors: a synthesis of fire policy and science. *Conservation Biology* 18: 976-86.

[13] McCune, Bruce. "Ecological diversity in North American pines." American Journal of Botany (1988): 353-368.

[14] Arno, S.F. 2000. Fire in western ecosystems. Pp. 97-120 in: J.K. Brown and J.K. Smith (eds.). *Wildland Fire in Ecosystems, Vol. 2: Effects of Fire on Flora*. USDA For. Serv. Gen. Tech. Rep. RMRS-42-vol.2. Ogden, UT.

[15] Omi, P.N., and E.J. Martinson. 2002. *Effect of Fuels Treatment on Wildfire Severity*. Unpubl. report to Joint Fire Science Program. Fort Collins: Colorado State Univ. Western Forest Fire Research Ctr. March 25. 36 pp.

resilience.[17,18] Research demonstrates no advantage in fire hazard mitigation resulting from mechanical forest treatments that remove large trees compared to treatments that retain them. Modeled treatments that removed only trees smaller than 16-inches diameter were marginally more effective at reducing long-term fire hazard than so-called "comprehensive" treatments that removed trees in all size classes.[19]

Thinning small trees and pruning branches of large trees to increase canopy base height significantly decreases the likelihood of crown fire initiation,[20,21,22,23] which is a precondition to active crown fire behavior.[24,25] Therefore, low thinning and underburning to reduce surface fuels and increase canopy base height at strategic locations effectively reduces fire hazard at a landscape scale and meets the purpose and need.

Large trees are not abundant at any scale in Southwestern forests and they are the most difficult of all elements of forest structure to replace once removed.[26] The ecological significance of old

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[16] Pollett, J. and P.N. Omi. 2002. Effect of thinning and prescribed burning on crown fire severity in ponderosa pine forests. *International Journal of Wildland Fire* 11: 1-10.

[17] Brown, R.T., J.K. Agee, and J.F. Franklin. 2004. Forest restoration and fire: principles in the context of place. *Conservation Biology* 18: 903-12.

[18] Naficy, C., A. Sala, E.G. Keeling, J. Graham and T.H. DeLuca. 2010. Interactive effects of historical logging and fire exclusion on ponderosa pine forest structure in the northern Rockies. *Ecological Applications* 20: 1851-64.

[19] Fiedler, C.E., and C.E. Keegan. 2003. Reducing crown fire hazard in fire-adapted forests of New Mexico. Pp. 29-38 in: P.N. Omi and L.A. Joyce (tech. eds.). *Fire, Fuel Treatments, and Ecological Restoration: Conference Proceedings*. 2002 April 16-18: Fort Collins, CO. USDA For. Serv. Rocky Mtn. Res. Sta. Proc. RMRS-P-29. Fort Collins, CO.

[20] Graham, R.T., S. McCaffrey, and T.B. Jain (Tech. Eds.). 2004. *Science Basis for Changing Forest Structure to Modify Wildfire Behavior and Severity*. USDA For. Serv. Rocky Mtn. Res. Sta. Gen. Tech. Rep. RMRS-120. Ft. Collins, CO.

[21] Keyes, C.R. and K.L. O'Hara. 2002. Quantifying stand targets for silvicultural prevention of crown fires. *Western Journal of Applied Forestry* 17: 101-09.

[22] Perry, D.A., H. Jing, A. Youngblood, and D.R. Oetter. 2004. Forest structure and fire susceptibility in volcanic landscapes of the eastern high Cascades, Oregon. *Conservation Biology* 18: 913-26.

[23] Omi and Martinson 2002, Pollett and Omi 2002

[24] Agee, J.K. 1996. The influence of forest structure on fire behavior. Pp. 52-68 in: J.W. Sherlock (chair). *Proc. 17th Forest Vegetation Management Conference.* 1996 Jan. 16-18: Redding, CA. Calif. Dept. Forestry and Fire Protection: Sacramento.

[25] Van Wagner, C.E. 1977. Conditions for the start and spread of crown fire. *Canadian Journal of Forest Research* 7: 23-24.

[26] Agee, J.K. and C.N. Skinner. 2005. Basic principles of forest fuel reduction treatments. *Forest Ecology and Management* 211: 83-96.

growth forest habitat and large trees comprising it is widely recognized.[27,28] There is no agreed-upon scientific basis for removing large trees to promote fire resistance in southwestern forests.[29,30] In addition to their rarity, a variety of factors other than logging threatens the persistence of the remaining large trees in Southwestern conifer forests. Recruitment of large trees, snags and large woody debris will become more limiting over time as climate change imposes chronic drought, reduced tree growth rates, and more widespread tree mortality.[31,32,33,34,35] A large tree retention alternative (which we propose) would maintain trees that are most likely to survive fire injury and supply recruitment structure that will support the recovery of old growth forest habitat in the future.

In forests with a variety of species and disturbance regimes, large tree removal reduces forest canopy and diminishes recruitment of large snags and downed logs, which in turn affects long-term forest dynamics, stand development and wildlife habitat suitability.[36,37,38] If significant

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[27] Friederici, P. (Ed.). 2003. *Ecological Restoration of Southwestern Ponderosa Pine Forests*. Island Press: Washington, DC.

[28] Kaufmann, M.R., W.H. Moir, and W.W. Covington. 1992. Old-growth forests: what do we know about their ecology and management in the Southwest and Rocky Mountain regions? Pp. 1-10 in: M.R. Kaufmann, W.H. Moir, and R.L. Bassett (eds.). *Old-Growth Forests in the Southwest and Rocky Mountain Regions: Proceedings from a Workshop* (1992). Portal, AZ. USDA For. Serv. Gen. Tech. Rep. RM-213. Fort Collins, CO.

[29] Allen, C.D. M.A. Savage, D.A. Falk, K.F. Suckling, T.W. Swetnam, T. Schulke, P.B. Stacey, P. Morgan, M. Hoffman, and J.T. Klingle. 2002. Ecological restoration of southwestern ponderosa pine ecosystems: A broad perspective. *Ecological Applications* 12: 1418-33.

[30] Brown et al. 2004, Dellasala et al. 2004

[31] Diggins, C., P.Z. Fulé, J.P. Kaye and W.W. Covington. 2010. Future climate affects management strategies for maintaining forest restoration treatments. *International Journal of Wildland Fire* 19: 903-13.

[32] Savage, M. P.M. Brown, and J. Feddema. 1996. The role of climate in a pine forest regeneration pulse in the southwestern United States. *Ecoscience* 3: 310-18.

[33] Seager, R., M. Ting, Y. Kushnir, J. Lu, G. Vecchi, H. Huang, N. Harnik, A. Leetmaa, N. Lau, C. Li, J. Velez and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in southwestern North America. *Science* 316: 1181-84.

[34] van Mantgem, P.J., N.L. Stephenson, J.C. Byrne, L.D. Daniels, J.F. Franklin, P.Z. Fulé, M.E. Harmon, A.J. Larson, J.M. Smith, A.H. Taylor and T.T. Veblen. 2009. Widespread increase of tree mortality rates in the western United States. *Science* 323: 521-24.

[35] Williams, A.P., C.D. Allen, C.I Millar, T.W. Swetnam, J. Michaelsen, C.J. Still and S.W. Leavitt. 2010. Forest responses to increasing aridity and warmth in the southwestern United States. *PNAS* 107: 21289-94.

[36] Quigley, T.M., R.W. Haynes and R.T. Graham. 1996. *Disturbance and Forest Health in Oregon and Washington*. USDA For. Serv. Pac. Nor. Res. Sta. Gen. Tech. Rep. PNW-GTR-382. Portland, OR.

[37] Spies, T.A. 2004. Ecological concepts and diversity of old-growth forests. *Journal of Forestry* 102: 14-20.

reductions of crown bulk density are deemed necessary to meet the purpose and need then it is highly unlikely that the project will maintain habitat for threatened and sensitive wildlife species associated with closed-canopy forest.[39,40]

An unambiguous commitment to old and large tree retention would maintain wildlife habitat in the short-term and mitigate adverse effects of the proposed treatments. And it would avoid social disapproval, unnecessary delays, or litigation.

One of the most often cited scientific articles on southwestern ponderosa pine restoration stated that a core ecological restoration principle is:

"*Retain trees of significant size or age.—Large and old trees, especially those established before ecosystem disruption by Euro-American settlement, are rare, important, and difficult to replace. Their size and structural complexity provide critical wildlife habitat by contributing crown cover, influencing understory vegetation patterns, and providing future snags. Ecological restoration should protect the largest and oldest trees from cutting and crown fires, focusing treatments on excess numbers of small young trees. Given widespread agreement on this point, it is generally advisable to retain ponderosa trees larger than 41 cm (16 inches) dbh and all trees with old-growth morphology regardless of size (i.e., yellow bark, large drooping limbs, twisted trunks, flattened tops).*"[41]

By choosing to protect all old and large trees, how could you go wrong?

Recommendations for the issue of old and large tree retention and old growth protection:

The scoping document states that "*Large and mature trees are found throughout the project area*." We invite the Santa Fe National Forest to commit to protecting them. The history of forest restoration literature is replete with recommendations to retain old and large trees. Even though this Project is billed as a "resiliency" project it sits squarely on the shoulders of many "restoration" projects which paved the way. The Project should proudly recognize that old and large retention is the socially, ecologically, and scientifically right choice, and avoid making decisions that incite anger from the public.

► Implement an unambiguous prohibition of cutting any old tree in any situation except imminent danger to human life.

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[38] van Mantgem, P.J., N.L. Stephenson, J.C. Byrne, L.D. Daniels, J.F. Franklin, P.Z. Fulé, M.E. Harmon, A.J. Larson, J.M. Smith, A.H. Taylor and T.T. Veblen. 2009. Widespread increase of tree mortality rates in the western United States. *Science* 323: 521-24.

[39] Beier, P., and J. Maschinski. 2003. Threatened, endangered, and sensitive species. Pp. 206-327 in: P. Friederici (ed.). *Ecological Restoration of Southwestern Ponderosa Pine Forests*. Island Press: Washington, D.C.

[40] Keyes, C.R. and K.L. O'Hara. 2002. Quantifying stand targets for silvicultural prevention of crown fires. *Western Journal of Applied Forestry* 17: 101-09.

[41] Page 1425 in Allen, C.D. M.A. Savage, D.A. Falk, K.F. Suckling, T.W. Swetnam, T. Schulke, P.B. Stacey, P. Morgan, M. Hoffman, and J.T. Klingle. 2002. Ecological restoration of southwestern ponderosa pine ecosystems: A broad perspective. *Ecological Applications* 12(5): 1418-1433.

► Define "old trees" as those which are >150 years old at stump height or possess morphological characteristics of old age.[42] Don't cut any of them, not even poorly formed ones in old growth clumps or groups.

► Remove the 24" diameter cap and replace it with an 18" diameter cap in all vegetation types except when a tree poses an imminent danger to human life.

The scoping document states that "*In accordance with the Old Growth Standards outlined in the current Forest Plan, 20% of the forested areas in the Project Area would be identified, allocated and managed as old growth.*"

► Any subsequent NEPA document should provide a map that identifies these areas which are managed for old growth, including overlays of roads, trails, Mexican spotted owl and northern goshawk habitats, vegetation type, and topography.

► Any subsequent NEPA document should identify how management to achieve nebulous desired conditions as espoused in GTR-310 will maintain existing old growth and expand future old growth such that the full 20% of the Santa Fe National Forest is managed in old growth conditions.

► Any subsequent NEPA document should specify that areas managed for old growth will be treated with hand thinning and prescribed burning only and deferred from mechanical logging.

ISSUE 2: TREATMENTS IN MEXICAN SPOTTED OWL HABITAT.

The scoping document states that there are four Mexican spotted owl PACs in the Project area. That amounts to just 2,400 acres of the 50,566 acre Project area. The Center requests extreme caution - in fact, restrained conservatism - in thinning and burning in these PACs and all spotted owl habitats.

The 2012 Mexican spotted owl Recovery Plan states:

> "*Because it takes many years for trees to reach large size, we recommend that trees ≥46- cm (18 inches) dbh not be removed in stands designated as recovery nest/roost habitat unless there are compelling safety reasons to do so or if it can be demonstrated that removal of those trees will not be detrimental to owl habitat*."

The effects of mechanical thinning on the Mexican spotted owl have not been extensively studied and are not well understood. Prominent owl scientists have recently stated that "*Existing studies on the effects of fuels reduction treatments on spotted owls universally suggest negative*

[42] See attached 4FRI Old and Large Tree retention Strategy for reference to old tree morphological characteristics.

effects from these treatments"[43] and that "*forest restoration and thinning activities also may threaten owls and their existing habitat*."[44] Extreme caution must be taken in considering thinning within Mexican spotted owl habitat because "*No empirical studies have evaluated these management activities* [restoration thinning or logging] *on the Mexican spotted owl.*"[45]

Some relevant studies from dry, frequent fire adapted forests of southern California have published findings indicating deleterious effects of thinning of spotted owls. Stephens and colleagues[46] reported that in the Plumas National Forest of California, spotted owl territorial sites declined 43% within 3-4 years of landscape-scale thinning treatments, and following treatment owls redistributed across the landscape. A study by Lee and colleagues[47] reported that in the San Bernardino and San Jacinto of southern California, post-fire salvage logging further reduced California spotted owl occupancy rates beyond the initial impacts of wildfire, leading the authors to recommend that burned stands be monitored for occupancy prior to salvage logging. Elsewhere in the Sierra Nevada, Tempel and colleagues[48] found that, as expected, canopy cover and demographic rates were strongly positively related, and that medium intensity fuels reduction harvest were negatively related to owl reproduction. Other researchers have concluded that thinning effects would be less impactful than severe wildfire,[49] leading to uncertainty of the true impacts of thinning on spotted owls.

The Forest Service also has information—based on recent monitoring of Mexican spotted owls in the area of the Nuttall-Gibson Fire of 2004 in the Coronado National Forest—that Mexican spotted owls appear to survive and thrive in a post-fire environment.[50] This information directly

[43] Page 11 in Ganey, J.L., H.Yi Wan, S.A. Cushman, And C.D. Vojta. 2017. Conflicting Perspectives on Spotted Owls, Wildfire, and Forest Restoration. Fire Ecology 13(3) doi: 10.4996/fireecology.130318020.

[44] Page 8 in Yi Wan, H., J.L. Ganey, C.D. Vojta, and S.A. Cushman. 2018. Managing emerging threats to spotted owls. *The Journal of Wildlife Management.* DOI: 10.1002/jwmg.21423.

[45] Id at 8.

[46] Scott L. Stephens, Seth W. Bigelow, Ryan D. Burnett, Brandon M. Collins, Claire V. Gallagher, John Keane, Douglas A. Kelt, Malcolm P. North, Lance Jay Roberts, Peter A. Stine, Dirk H. Van Vuren. 2014. California Spotted Owl, Songbird, and Small Mammal Responses to Landscape Fuel Treatments. *BioScience* 64(10): 893-906.

[47] Lee, D.E., M.L. Bond, M. I. Borchert, and R. Turner. 2012. Influence of fire and salvage logging on site occupancy of spotted owls in the San Bernardino and San Jacinto Mountains of southern California. *The Journal of Wildlife Management* 77(7):1327-1341.

[48] Tempel, Douglas J., R.J. Gutierrez, Sheila A. Whitmore, Matthew J. Reetz, Ricka E. Stoelting, William J. Berigan, Mark E. Seamans, and Zachariah Peery. 2014. Effects of forest management on California spotted owls: implications for reducing wildfire in fire-probe forests. *Ecological Applications* 24(8):2089-2106.

[49] Lee, D.C., and L.L. Irwin. 2005. Assessing risks to spotted owls from forest thinning in fire-adapted forests of the western United States. *Forest Ecology and Management* 211:191-209.

[50] See "Occupancy and Reproductive Success of Mexican Spotted Owls in the Pinaleno Mountains, Safford Ranger District, Arizona: 2011" ("the owl population in the Pinaleno Mountains has demonstrated the capability of reproducing well, despite of or even with the aid of effects promulgated by the large, and in some areas, severely burning Nuttall-Gibson fire of 2004").

undercuts the 2012 Mexican spotted owl revised Recovery Plan's assumptions with respect to Mexican spotted owl responses to fire and, more importantly, the conclusion that the risk to Mexican spotted owl habitat posed by the threat of fire justifies large-scale restoration projects which is itself associated with significant negative effects to the Mexican spotted owl and its habitat.

Interestingly, evidence suggests that wildfire may actually promote the recovery of the Mexican spotted owl despite the 2012 Revised Recovery Plan's suggestion to the contrary. A recent paper published by owl experts asserts that the 'debate' over the impacts of fire or logging to spotted owls is not settled:

> "*Here, we argue that the existing literature is not sufficient to unambiguously quantify the response of spotted owls to high-severity wildfire, and that high-severity fire is pervasive enough within the range of the spotted owl to constitute a potential threat to owl habitat. We also provide evidence that forest restoration and fuels reduction treatments can mitigate fire behavior, but acknowledge that these treatments also can degrade spotted owl habitat. Based on these findings, we argue for cautious implementation of restoration treatments in or near spotted owl habitat, with the goal of identifying treatment types that successfully reduce fire risk while maintaining suitable habitat conditions for spotted owls*."[51]

A similar meta-analysis concluded that "*mixed-severity fire does not appear to be a serious threat to owl populations; rather, wildfire has arguably more benefits than costs for Spotted Owls*."[52] In another recent paper, scientists reiterate our concern that:

> "*Commercial timber harvesting remains a potential threat for all 3 spotted owl subspecies, but effects from forest thinning may be increasing because of the heightened emphasis on fuels reduction and forest restoration treatments on public lands. Owl response to mechanical tree removal, especially forest thinning, remains understudied.*"[53]

Notably, these researchers identified that threats to Mexican spotted owl are comparatively less studied than for other spotted owl subspecies:

> "*Mexican spotted owl papers represented a small fraction of manuscripts among major research topics, except for habitat selection ... Because the Mexican spotted owl was listed as Threatened primarily because of concerns over habitat loss, it is understandable that a relatively high proportion of Mexican spotted owl studies have focused on characterizing habitat. The general lack of population*

[51] Page 4 in Ganey, J.L., H. Yi Wan, S.A. Cushman, and C.D. Vojta. 2017. Conflicting Perspectives on Spotted Owls, Wildfire, and Forest Restoration. Fire Ecology 13(3) doi: 10.4996/fireecology.130318020.

[52] Page 1 in Lee, D.E. 2018. Spotted Owls and forest fire: a systematic review and meta-analysis of the evidence. *Ecosphere* 9(7):e02354. 10.1002/ecs2.2354.

[53] Page 1 in Yi Wan, H., J.L. Ganey, C.D. Vojta, and S.A. Cushman. 2018. Managing emerging threats to spotted owls. *The Journal of Wildlife Management.* DOI: 10.1002/jwmg.21423.

> *dynamics studies for the Mexican spotted owl, however, is notable, and severely limits our understanding of factors causing population fluctuations in this owl and how it might respond to emerging threats*."[54]

Regardless of uncertainty in the literature or in the 2012 MSO Recovery Plan, caution is warranted. Many Forests are not taking caution and are risking serious impacts to owls. For example, the Prescott National Forest recently issued a Draft Decision Notice (Hassayampa Landscape Restoration Project) approving a plan to log in more than ½ of the PACs on the entire Forest with no diameter caps, no codified incorporation of management recommendations in Table C.2 or C.3 of the Recovery Plan, and also allowing mechanical treatment up to 80% slope. That project also doesn't include any "comprehensive" restoration practices like riparian restoration, making it a perfect example of a project that is "landscape restoration" in name only. Unless a BiOp addresses our concerns, it is likely that this project will be met with fierce legal resistance.

Currently, the best science indicates that the cautious approach presented in the 2012 Mexican spotted owl Recovery Plan should be followed, specifically guidelines in Tables C.2 and C.3. The 2012 Plan (at 284) states that:

> "*The values provided in Table C.2 define desired conditions to be achieved with time and management, or to be maintained where they already exist.* ***These values are based on the lower bound of 95% confidence intervals around estimates of means computed across stands.*** *Consequently, we view these values as minimum targets for managers. We also stress that values in Table C.2 must be met simultaneously. Management can occur within stands that exceed these minimum conditions, but such activities should not lower stand characteristics below these levels unless large-scale assessments demonstrate that such conditions occur in a surplus across the landscape*."

A complete monitoring plan for Mexican spotted owl, including study design and analysis protocols, should be made available for public review and comment before a decision is made to implement the project. The Center has specific questions regarding the monitoring plan, including but not limited to: (1) criteria for selection of PAC as paired treatment and control sites; (2) criteria for selection of measurable indicators of change; (3) sampling design power analysis and expected observational error rates; (4) sampling procedures including monitoring cycle; (5) confidence levels to be applied in data analysis and reporting; (6) timeframe for evaluation of results; and (7) triggers for management adaptation using new information. Furthermore, need for any amendment of the Forest Plan with respect to Mexican spotted owl and its critical habitat is a significant issue for analysis.

Recommendations for issue of treatments in Mexican spotted owl habitat:

Because of uncertainty over the effects of thinning on the Mexican spotted owl, we request that a conservative approach be taken to managing their habitats. We request the following:

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[54] Id at 7.

► Defer any thinning or burning in owl PACs if breeding is detected.

► Do not thin (hand or mechanical) during breeding season (March 1 to August 31) within or adjacent to PACs by ¼ mile.

► Do not thin in nest cores, and use extreme caution with burning in next cores.

► In PACs outside of nest cores, limit thinning to hand felling of trees under 9" dbh, followed by pile burning, unless breeding is detected, then defer treatment.

► In forest, riparian, canyon, and woodland cover types typically used by Mexican spotted owls for nesting and roosting, limit thinning to a 17.9" dbh cutting limit, and conform to recommendations in Tables C.2 and C.3 of the 2012 Recovery Plan. "*Management can occur within stands that exceed these minimum conditions, but such activities should not lower stand characteristics below these levels unless large-scale assessments demonstrate that such conditions occur in a surplus across the landscape.*"[55]

► Any subsequent NEPA document should describe a monitoring plan in detail that is consistent with regional and USFWS direction for spotted owl monitoring, and addresses at the least the seven monitoring elements introduced above, consistent with BOX C.5. ASSESSING TREATMENT ACTIVITIES WITHIN PACs, OUTSIDE OF CORE AREAS of the 2012 Recovery Plan.

► Because spotted owls may use higher elevations forests than they currently are confirmed to use (due to scientific uncertainty or climate change effects), any subsequent NEPA document should describe how the Project will accommodate the considerations in BOX C.3. HIGH-ELEVATION, MIXED-CONIFER FOREST of the 2012 Recovery Plan.

ISSUE 3: TREATMENTS FOR DWARF MISTLETOE.

We recently toured, with a cadre of USFS staff, an active timber sale on the Apache-Sitgreaves NF where a very heavy cut was being completed because of perceived high severity mistletoe infection (August 29, 2018 site visit to Little Timber Sale, West Escudilla Landscape Restoration Project). The cutting has targeted many large and old trees, and reduced stand basal area predominantly in VSS 5+ classes.[56] This is contrary to many restoration objectives. We hope sincerely that the Santa Fe will avoid the humiliation we ushered onto the staff at the ASNF.

The Ecological Restoration Institute (ERI) recently released a new publication titled "*Restoration as a Mechanism to Manage Southwestern Dwarf Mistletoe in Ponderosa Pine Forests*" (attached to these comments). While the working paper does suggest that even-aged management is an appropriate response to moderate to severe infections, it is in the context of even aged groups separated by 40-80 feet between groups. It does not suggest even-aged

[55] 2012 Mexican spotted owl Recovery Plan at 284.

[56] See attached field report on the Little Timber Sale

approaches at scales larger than the group level. Of more importance, the report suggests that in severely infected stands, manager should use fire only, and that severely infested stands may be deferred and allowed to burn or left as wildfire habitat. Of most importance is the recommendation to retain presettlement trees, even if dwarf mistletoe is present. In this Project, this might include many VSS 5 trees that may otherwise be targeted for removal because of mistletoe due to the allowance to cut trees up to 24”, as stated in the scoping document. Elsewhere in this letter we make clear that we seek an 18” diameter cap for this Project.

This ERI working paper provides a table (below) of recommended silvicultural prescriptions for three levels of dwarf mistletoe infection. It recommends that old trees are retained, and if the infection is severe, to defer mechanical thinning and use fire only.

Compatible Silvicultural Prescription

Light to Moderate DM infestation:

- Uneven-aged prescriptions that are relatively open, maintaining groups of presettlement trees (old trees) with interspaces and openings (40-80 ft between groups).
- Group selection with thinning in the matrix; Retain all presettlement trees and use interspaces and openings with intergroup spacing of 40-80 ft.
- Be flexible and take advantage of opportunities to leave size/age class diversity.
- Repeated entries with prescribed fire are necessary to maintain openings.

Moderate to Severe DM infestation:

- Even-aged management maintaining groups of presettlement trees and openings (40-80 ft between groups).
- Group selection with thinning between groups. Retain all presettlement trees and remove all blackjacks. Maintain openings and interspaces (40-80 ft between groups).
- Be flexible. If DM infestation is patchy, may need to divide up stand at treat accordingly. Take advantage of opportunities to leave size/age class diversity.
- Repeated entries with prescribed fire are necessary to maintain openings.

Severe DM infestation:

- Use of fire only. Severely infested stands may be deferred and allowed to burn or left as wildfire habitat.

Allow us to include as an attachment to this letter the Centers objection letter to the West Escudilla Restoration Project and the Luna Restoration Project wherein we requested that the project incorporate 4FRI stakeholder-developed treatment approaches for stands with occurrence of southwestern dwarf mistletoe, as well as the 4FRI stakeholder’s letter addressing the unanimous rejection of the Forest Service’s proposals to utilize aggressive overstory removal and even-aged management approaches in treating stands infected with mistletoe.

The aforementioned 4FRI Stakeholders (SHG) letter of April 27, 2017, rejecting the Forest Service’s dwarf mistletoe proposal for 4FRI stated:

> • “*Dwarf mistletoe is a natural disturbance agent and component of coniferous forests within the planning area. The plant provides food and cover for wildlife; large-tree mortality caused by mistletoe is an important factor in recruiting snags that provide habitat for cavity-nesting birds and other species*.”
>
> • “*The historical and recent data presented by USFS did not make a compelling case that mistletoe infections within the planning area are significantly outside the natural range of variability and pose a meaningful obstacle to meeting restoration objectives*.”

> • "*The SHG feels that restoration treatments consisting of mechanical or hand thinning, followed by application of prescribed/managed fire at regular intervals, meet the intent of the Forest Plans and are the preferred approach for stands with high levels of mistletoe infection. Where needed, those stands could also be buffered to reduce mistletoe spread*."
>
> • "*The SHG also feels that traditional silvicultural approaches to managing dwarf mistletoe (e.g. overstory removal, even-aged management) are inconsistent with an ecological restoration approach and are not supported by the best available science*."

The 4FRI stakeholders group consists of representatives of the Center, The Nature Conservancy, the Ecological Restoration Institute, the Sierra Club, Grand Canyon Trust, partner federal and state agencies, local and regional governments, the timber industry, and others. If we could agree in consensus to reject the sanitation of mistletoe on the 4FRI landscape, the Santa Fe Mountains Landscape Resiliency Project can do it too.

Recommendation for the issue of mistletoe treatment:

> ►Any subsequent NEPA analysis should be unambiguous in stating that no large (>18") or old (>150 years) tree will be cut because of disease occurrence, and any treatment of mistletoe should be in accordance with accepted uneven-aged restoration prescriptions.

ISSUE 4: EFFECTS OF LIVESTOCK GRAZING ON MEETING PROJECT PURPOSE AND NEED.

The scoping document (p. 10) states that "*The primary resource concerns for riparian areas in the Project Area include departed vegetative conditions, wildfire risk, and impacts to water quality from roads and trails*" and that "*Fencing may be installed if needed to protect restored areas if it is determined that riparian vegetation regeneration is being hampered by browsing and grazing*" (p.14). These statements constitute a brazen dismissing of reality; that livestock grazing has destroyed many of New Mexico's ecosystems.

Livestock grazing an important factor to consider that adversely impacts ecosystem health and fire regime and will reduce the effectiveness of the proposed treatments in moving towards desired conditions. Potentially significant cumulative effects to soil productivity, plant communities, fire regime and wildlife may result from fuel management in combination with livestock grazing and other activities which disturb soils and spread exotic plant species.

Livestock grazing is a primary driver of fire regime disruption

Livestock grazing decreases understory biomass and density, reducing competition with conifer seedlings and reducing the ability of the understory to carry low-intensity fire, contributing to dense forests with altered species composition.[57] Livestock grazing directly contributes to fire

[57] Belsky A.J. and D.M. Blumenthal. 1997. Effects of livestock grazing on stand dynamics and soils in upland forests of the Interior West. *Conservation Biology* 11:316-27.

hazard in the project area by impairing soil productivity and altering vegetation communities, which indirectly contribute to delayed fire rotations, increased forest density, and reduced forage opportunities for herbivorous species and predators.

Continued livestock grazing risks post-treatment invasion of exotic plants

Livestock facilitate the spread of exotic species, particularly in combination with fire, and reduce the competitive and reproductive capacities of native species.[58] Exotic plant species, once established, can displace native species, in part, because native grasses are not adapted to frequent and close grazing in combination with fire disturbance.[59/60/61]

Livestock disturb soil, enable seeds of exotic species to spread, and reduce the competitive and reproductive capacities of native species. Exotic plant species, once established, can displace native species, in part, because native grasses are not adapted to frequent and close grazing in combination with fire disturbance.

Exotic plant spread is a potentially significant cumulative impact of the proposed action. Treatments similar to the proposed action in northern Arizona left forest sites overrun with cheatgrass (*Bromus tectorum*). Although it is not extensive in the project area today, exotic grass invasion is foreseeable and has important long-term implications for native plant communities in fire-adapted ecosystems and wildlife. Melgoza and others (1990[62]) studied cheatgrass soil resource acquisition after fire and noted its competitive success owing to its ability suppress the water uptake and productivity of native species for extended periods of time. They further showed that cheatgrass dominance is enhanced by its high tolerance to grazing. Its annual life-form coupled with the abilities to germinate readily over a wide range of moisture and temperature conditions, to quickly establish an extensive root system, and to grow early in the spring contribute to its successful colonization. In addition, Melgoza and others showed that cheatgrass successfully competes with the native species that survive fire, despite these plants being well-established adult individuals able to reach deeper levels in the soil. This competitive ability of cheatgrass contributes to its dominance when lands experience synergistic disturbances from grazing, mechanical treatments, and fire.

Continued livestock grazing threatens success of improving and maintaining diverse wildlife habitats and improving watershed conditions

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[58] Brooks, M.L., C.M. D'Antonio, D.M. Richardson, J. B. Grace, J.E. Keeley, J. M. DiTomaso, R.J. Hobbs, M. Pellant and D.Pyke. 2004. Effects of invasive alien plants on fire regimes. *BioScience* 54(7):677-688.

[59] Mack, R. N., and J. N. Thompson. 1982. Evolution in steppe with few large, hooved mammals. *American Naturalist* 119:757-72.

[60] Melgoza, G., R.S. Nowak and R.J. Tausch. 1990. Soil water exploitation after fire: competition *between Bromus tectorum* (cheatgrass) and two native species. *Oecologica* 83:7-13.

[61] Belsky, A.J., and J.L. Gelbard. 2000. Livestock Grazing and Weed Invasions in the Arid West. Oregon Natural Desert Association: Portland, OR. April. 31 pp.

[62] Melgoza, G., R.S. Nowak and R.J. Tausch. 1990. Soil water exploitation after fire: competition *between Bromus tectorum* (cheatgrass) and two native species. *Oecologica* 83:7-13.

Grazing of the most nutritious plants by livestock results in a loss of forage for native species and can alter habitat or insect prey base.[63/64] A decrease in prey base inevitably leads to a decrease in carnivores in the area, which are also eliminated by the government at the request of the livestock community. "*The productivity, diversity, and species richness of native grasslands are threatened by competition from noxious and invasive weeds/grasses. Productivity is threatened by other factors including drought, soil erosion, fire suppression, and improper livestock management practices.*"[65] Grazing also has negative effects on songbirds, reptiles and other mammals especially if their habitat is close to the ground.[66] Rosenstock and Van Riper reported that "*Livestock grazing and fire suppression commonly are cited as causes of woodland expansion.*"[67] Because of the severity and broad array of grazing impacts, livestock grazing is one of the most prevalent causes of species being federally listed in this region, especially those which are specifically dependent on aquatic and riparian habitat.[68/69/70]

Project purpose cannot be met with continued livestock grazing in riparian areas

Livestock grazing has both direct and indirect effects on streams. Livestock directly affect riparian habitats through removal of riparian vegetation[71] which in turn raises water

[63] Donahue, D. 1999. The Western Range Revisited: Removing Livestock from Public Lands to Conserve Native Biodiversity. Norman, OK: University of Oklahoma Press. 338 pages.

[64] Kie, John G., Charles J. Evans, Eric R. Loft, and John W. Menke. 1991. Foraging behavior by mule deer: the influence of cattle grazing. *The Journal of Wildlife Management* 55(4):665-674.

[65] Central Arizona Grasslands Conservation Strategy, page 21

[66] Finch, D.M., and W. Block, technical editors. 1997. Songbird ecology in southwestern ponderosa pine forests: a literature review. Gen. Tech. Rep. RM-GTR-292. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 152 p.

[67] Rosenstock, S. S. and Van Riper III, C. (2001) Breeding Bird Responses to Juniper Woodland Expansion. *Journal of Range Management*, 54:226-232.

[68] *See* 60 Fed. Reg. at 10707 ("*Overuse by livestock has been a major factor in the degradation and modification of riparian habitats in the United States … Livestock grazing in riparian habitats typically results in reduction of plant species diversity and density, especially of palatable plants like willow and cottonwood saplings*.")

[69] *See* 77 Fed. Reg. at 10,818)("*Impacts associated with roads and bridges, changes in water quality, improper livestock grazing, and recreation have altered or destroyed many of the rivers, streams, and watershed functions in the ranges of the spikedace and loach minnow*.").

[70] *See* 79 Fed. Reg. at 38718 ("*We found numerous effects of livestock grazing that have resulted in the historical degradation of riparian and aquatic communities that have likely affected northern Mexican and narrow-headed gartersnakes.*")

[71] *See* Clary, W. P., B. F. Webster. 1989. Managing grazing of riparian areas in the Intermountain Region. USDA Forest Service; Clary, W. P., D. E. Medin. 1990. Differences in vegetation biomass and structure due to cattle grazing in a northern Nevada riparian ecosystem. USDA Forest Service; Schulz, T. T., and W.C. Leininger. 1990. Differences in riparian vegetation structure between grazed areas and exclosures. *Journal of Range Management* 43(4): 295-299; and Armour, C. L., D. A. Duff, and W. Elmore. 1991. The effects of livestock grazing on riparian and stream ecosystems. *Fisheries* 16(1):7-11.

temperatures,[72/73] reduces bank stability and eliminates an important structural component of the stream environment that contributes to the formation of pools,[74] and by physically altering streambanks through trampling and shearing, leading to bank erosion.[75] Livestock also indirectly impact aquatic and riparian habitats by compacting soils, altering soil chemistry and reducing vegetation cover in upland areas, leading to increased severity of floods and sediment loading, lower water tables and altered channel morphology.[76]

Treated areas need substantial rest from or exclusion of livestock grazing

A critical and often overlooked consideration in effective vegetation treatments is the necessity for resting a treated area from domestic livestock grazing to allow establishment of fine fuels such that low-intensity ground fire can be applied to the forest floor, and aligning allotment management plans such that future livestock grazing does not deplete the fine fuels that are required to maintain a prescribed fire schedule. The Ecological Restoration Institute reviewed the research and perspectives on resting from grazing, and concluded that:

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[72] Kondolf, G. Mathias, Richard Kattelmann, Michael Embury, and Don C. Erman. 1996. Status of riparian habitat. Sierra Nevada Ecosystem Project: Final report to Congress, Volume 2

[73] Beschta, R.L., D.L. Donahue, D.A. DellaSala, J.J. Rhodes, J.R. Karr, M.H. O'Brien, T.L. Fleischner and C.D. Williams. 2013. Adapting to climate change on western public lands: addressing the ecological effects of domestic, wild, and feral ungulates. *Environmental Management* 51: 474-91.

[74] *See* Meehan, W. R., F.J. Swanson, and J.R. Sedell. 1977. Influences of riparian vegetation on aquatic ecosystems with particular reference to salmonid fishes and their food supply. USDA Forest Service; Kauffman, J. B., W. C. Krueger. 1984. Livestock impacts on riparian plant communities and streamside management implications. A review. *Journal of Range Management* 37(5): 430-438; Minckley, W.L., and J.N. Rinne. 1985. Large woody debris in hot-desert streams: an historical review. *Desert Plants* 7(3):142-153; and Platts, W. S. 1990. Managing fisheries and wildlife on rangelands grazed by livestock: A guidance and reference document for biologists, unpublished document, Nevada Department of Wildlife.

[75] *See* Armour, C.L. 1977. Effects of deteriorated range streams on trout. U.S. Bureau of Land Management, Boise, ID. 7 pp; Platts, W.S., and R.L. Nelson. 1985. Stream habitat and fisheries response to livestock grazing and instream improvement structures, Big Creek, Utah. *Journal of Soil and Water Conservation* 40(4):374-379; and Trimble, S.W., and A.C. Mendel. 1995. The cow as a geomorphic agent - a critical review. *Geomorphology* 13(1995):233-253.

[76] *See* Cooperrider, C. K. and B. A. Hendricks. 1937. Soil erosion and streamflow on range and forest lands of the upper Rio Grande watershed in relation to land resources and human welfare, USDA Technical Bulletin 567; Sartz, R. S., and D.N. Tolsted. 1974. Effect of grazing on runoff from two small watersheds in southwestern Wisconsin. *Water Resources Research* 10(2): 354-356; Gifford, G. F., R. H. Hawkins. 1978. Hydrologic impact of grazing on infiltration: a critical review. *Water Resources Research* 14: 305-313; Blackburn, W. H., R. W. Knight, M.K. Wood. 1982. Impacts of grazing on watersheds: a state of knowledge. College Station, Texas, Texas Agricultural Experiment Station, Texas A&M University; Orodho, A.B., M.J. Trlica, and C.D. Bonham. 1990. Long-term heavy-grazing effects on soil and vegetation in the four corners region. *The Southwestern Naturalist* 35(1):9-15; Schlesinger, W.H., J.R. Reynolds, G.L. Cunningham, L.F. Huenneke, W.M. Jarrell, R.A. Virginia, and W.G. Whitford. 1990. Biological feedbacks in global desertification. Science 246:1043-1048; and Elmore, W., and B. Kauffman. 1994. Riparian and watershed systems: degradation and restoration. Pp 212-231 in M. Vavra, W. A. Laycock, and R. D. Pieper, editors. Ecological implications of livestock herbivory in the west. Society for Range Management, Denver, CO.

> "*These research findings, although limited, suggest that federal agencies should be prepared to wait more than two years before allowing domestic grazing on restored allotments lest they jeopardize two important goals of restoration treatments—restoring the understory and returning low-intensity prescribed fire as an ecosystem process.*"[77]

Livestock need to be permanently excluded from riparian areas

The scoping document (p. 14) states that in riparian areas "*fencing may be installed if needed to protect restored areas if it is determined that riparian vegetation regeneration is being hampered by browsing and grazing.*" The near-complete and permanent removal of livestock from all riparian areas is necessary to ensure full restoration of these crucial habitats and scenic recreational gems.

As briefed here, the scientific literature documenting the impacts of livestock grazing on ecosystems is extensive, and universally shows severe and lasting negative impacts. The only is widely accepted way to eliminate these impacts and preserve stream health is the near-complete exclusion of cattle.[78]

Consider the following:

• An example of where removal of cattle from rangelands for 35 years led to the disappearance of rabbitbrush from previously shrub-dominated communities - and native grasses regained dominance;[79]

• An example of where Forest Service scientists at the Intermountain Forest and Range Experiment Station found that protection of an Idaho range from grazing increased grass and forb production by 30% and decreased shrub production by 20%.[80]

• An example of where University of Idaho range scientists documented a 20-fold increase in perennial grass cover after 25 years of grazing exclusion while shrub cover only increased by

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[77] Egan, D. 2011. Integrating Domestic and Wild Ungulate Grazing into Forest Restoration Plans at the Landscape Level. Issues in Forest Restoration, ERI White papers. Ecological Restoration Institute, Flagstaff, AZ. 14p.

[78] Fleischner, T.L. 1994. Ecological costs of livestock grazing in western North America. *Conservation Biology* 8(3):629-644.

Conservation Biology 8(3): 629-644; Ohmart, R. D. 1996. Historical and present impacts of livestock grazing on fish and wildlife resources in western riparian habitats. Rangeland Wildlife. P. R. Krausman. Denver, CO, Society for Range Management; and Belsky, A. J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. *Journal of Soil and Water Conservation* 54(1):419-431.

[79] Austin, D.D., and P.J. Urness. 1998. Vegetal change on a northern Utah foothill range in the absence of livestock grazing between 1948 and 1982. *Great Basin Naturalist* 58(2): 188-191.

[80] Laycock, W.A. 1967. How heavy grazing and protection affect sagebrush-grass ranges. *Journal of Range Management* 20: 206-213.

1.5-fold, attributing the grass response to "*the availability of seeds as formerly depleted populations increase in size*."[81]

• An example of where in a southeastern Arizona rangeland excluded from cattle grazing for 14 years, grass cover was 45% higher, the grass community was more heterogeneous, herb cover was higher, and rodent and bird numbers were higher than grazed comparison areas.[82]

• USDA research has found that excluding cattle from a landscape for five growing seasons "*significantly increased: (1) total vegetative cover, (2) native perennial forb cover, (3) grass stature, (4) grass flowering stem density, and (5) the cover of some shrub species and functional groups.*"[83]

Recommendations on the issue of the effects of livestock grazing on meeting project purpose and need:

Persistent livestock grazing is a component of the compromised ecological condition of the Southwest's forests and riparian areas. We request that in any subsequent NEPA document related to the Santa Fe Mountains Landscape Resiliency Project that:

> ► The Forest Service should analyze the effects of livestock grazing on the success of the proposed vegetation treatments in achieving and maintaining desired future conditions as they relate to fire use, migratory bird, native fish and other sensitive species populations and habitats.

Recent studies into livestock grazing management[84/85] have identified ways to reduce negative impacts, primarily through changes in agency management of forage resources and grazing to reflect best available science. These changes would contribute significantly to improving the habitat for a range of species in the Project. We request that in any subsequent NEPA document related to the Santa Fe Mountains Landscape Resiliency Project:

> ► The Forest Service should identify areas with degraded soils or plant communities, areas with sensitive or high-erosion soils, and areas in need of recovery, and reduce or

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[81] Anderson, J.E., and K.E. Holte. 1981. Vegetation development over 25 years without grazing on sagebrush-dominated rangeland in southeastern Idaho. *Journal of Range Management* 34:25-29.

[82] Bock, C.E., J.H. Bock, W.R. Kenney, and V.M. Hawthorne. 1984. Responses of birds, rodents, and vegetation to livestock exclosure in a semidesert grassland site. *Journal of Range Management* 37(3): 239-242.

[83] Kerns, Becky K., Michelle Buonopane, Walter G. Thies, and Christine Niwa. 2011. Reintroducing fire into a ponderosa pine forest with and without cattle grazing: understory vegetation response. *Ecosphere* 2(5):1-23.

[84] Carter, J., J. Chard, and B. Chard. 2011. Moderating Livestock Grazing Effects on Plant Productivity, Nitrogen and Carbon Storage. *In* Monaco, T.A. *et al.,* 2011. Proceedings – Threats to Shrubland Ecosystem Integrity; May 18-20, 2010, Logan, UT. *Natural Resources and Environmental Issues* 17.

[85] Carter, J., J.C. Catlin, N. Hurwitz, A.L. Jones, and J. Ratner. 2017. Upland water and deferred rotation effects on cattle use in riparian and upland areas. *Rangelands* 39(3-4): 112-118.

eliminate grazing in those pastures altogether to contribute to the success of resiliency treatments.

Removal of livestock grazing pressure from riparian areas has been found to have a positive effect on growth, distribution, and vigor of riparian communities.[86] We request that in any subsequent NEPA document related to the Santa Fe Mountains Landscape Resiliency Project:

► The Forest Service should permanently fence livestock out of riparian areas.

The Center's proposed alternative includes these three recommendations for analysis independent from the baseline proposed action.

ISSUE 5: CONDITIONS BASED MANAGEMENT, MONITORING, AND ADAPTIVE MANAGEMENT.

The scoping notice (pp. 11-12) states

> "*This Proposed Action does not define specific treatment units, but rather general areas throughout the project area where treatments are most likely to occur and the suite of tools that would be used. We do not have complete information about the conditions found on every acre, but we do have enough information to make informed decisions about the types of treatments that work best in certain conditions… This 'condition-based' approach provides flexibility and lets us account for imperfect information and adapt to changes in environmental conditions*."

The Center finds this approach troubling considering the amount of time and attention that has been given to this project already. Was there not a voluminous modelling study completed by The Nature Conservancy? Why wouldn't these data and results be used in this analysis? Weren't useful data used in that project?

The Forest service has some serious explaining to do to validate their abandonment of baseline conditions and real project planning.

"*In analyzing the affected environment, NEPA requires the agency to set forth the baseline conditions.*"[87] Specifically, NEPA requires agencies to "*succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration*."[88] The Council on Environmental Quality, the agency charged with interpreting NEPA, has explained that "*[t]he concept of a baseline against which to compare predictions of the effects of the proposed action*

[86] Schulz, Terri Tucker, and Wayne C. Leininger. 1990. Differences in riparian vegetation structure between grazed areas and exclosures. Journal of Range Management 43(4):295-299.

[87] *Western Watersheds Project v. BLM*, 552 F.Supp.2d 1113, 1126 (D. Nev. 2008)

[88] 40 C.F.R. § 1502.15.

and reasonable alternatives is critical to the NEPA process."[89] Federal courts hold that "*[w]ithout establishing ... baseline conditions ... there is simply no way to determine what effect [an action] will have on the environment and, consequently, no way to comply with NEPA*."[90]

Without baseline data, neither the public nor the agency can understand the effects of the proposed action or craft and analyze alternatives and mitigation measures to protect these values. As such, the Forest Service must identify the environmental baseline and affected environment, as well as the scope of impacts and where those impacts are most likely to be felt. The vague "conditions-based" approach does not satisfy this requirement.

NEPA requires federal agencies to take a "*hard look*" at the environmental impacts of proposed actions.[91] To do so, federal agencies must prepare an environmental impact statement (EIS) for all "*major Federal actions significantly affecting the quality of the human environment*."[92] An EIS must "*provide [a] full and fair discussion of significant environmental impacts*" associated with a federal decision and "*inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment*."[93] Taking the required "*hard look*" requires agencies to "*utiliz[e] ... the best available scientific information*."[94]

NEPA's review obligations are more stringent and detailed at the project level, or "*implementation stage*," given the nature of "*individual site specific projects*."[95] "[G]*eneral statements about possible effects and some risk do not constitute a hard look, absent a justification regarding why more definitive information could not be provided*."[96]

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[89] Council on Environmental Quality, Considering Cumulative Effects Under the National Environmental Policy Act 41 (1997), https://ceq.doe.gov/publications/cumulative_effects.html (last visited July 5, 2019).

[90] *Half Moon Bay Fishermans' Mktg. Ass'n v. Carlucci*, 857 F.2d 505, 510 (9th Cir. 1988); *see also N. Plains Res. Council, Inc. v. Surface Transp. Bd.*, 668 F.3d 1067, 1084–85 (9th Cir. 2011) (holding that agency did not take a sufficiently "hard look" at environmental impacts because it did not collect baseline data).

[91] *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 (1989).

[92] 42 U.S.C. § 4332(2)(C); *see also* 40 C.F.R. § 1501.4.

[93] 40 C.F.R. § 1502.1.

[94] *Colo. Envtl. Coal. v. Dombeck*, 185 F.3d 1162, 1171 (10th Cir. 1999).

[95] *Ecology Ctr., Inc. v. United States Forest Serv.*, 192 F.3d 922, 923 n.2 (9th Cir. 1999); *see also Friends of Yosemite Valley v. Norton*, 348 F.3d 789, 800-01 (9th Cir. 2003); *New Mexico ex rel Richardson v. Bureau of Land Management*, 565 F.3d 683, 718-19 (10th Cir. 2009) (requiring site-specific NEPA analysis when no future NEPA process would occur); *Colo. Envtl. Coal. v. Ofc. of Legacy Mgmt*., 819 F. Supp. 2d 1193, 1209-10 (D. Colo. 2011) (requiring site-specific NEPA analysis even when future NEPA would occur because "environmental impacts were reasonably foreseeable").

[96] *Or. Natural Res. Council Fund v. Brong*, 492 F.3d 1120, 1134 (9th Cir. 2007) (citation omitted); *see also Or. Natural Res. Council Fund v. Goodman*, 505 F.3d 884, 892 (9th Cir. 2007) (holding the Forest Service's failure to discuss the importance of maintaining a biological corridor violated NEPA, explaining that "[m]erely disclosing the existence of a biological corridor is inadequate" and that the agency must "meaningfully substantiate [its] finding").

Analyzing and disclosing site-specific impacts is critical because where (and when and how) activities occur on a landscape strongly determines that nature of the impact. As the Tenth Circuit Court of Appeals has explained, the actual "*location of development greatly influences the likelihood and extent of habitat preservation. Disturbances on the same total surface area may produce wildly different impacts on plants and wildlife depending on the amount of contiguous habitat between them*."[97] The Court used the example of "*building a dirt road along the edge of an ecosystem*" and "*building a four-lane highway straight down the middle*" to explain how those activities may have similar types of impacts, but the extent of those impacts – in particular on habitat disturbance – is different.[98] Indeed, "*location, not merely total surface disturbance, affects habitat fragmentation*,"[99] and therefore location data is critical to the site-specific analysis NEPA requires.

NEPA further mandates that the agency provide the public *"'the underlying environmental data' from which the Forest Service develop[ed] its opinions and arrive[d] at its decisions*."[100] "*The agency must explain the conclusions it has drawn from its chosen methodology, and the reasons it considered the underlying evidence to be reliable*."[101] In the end, "*vague and conclusory statements, without any supporting data, do not constitute a 'hard look' at the environmental consequences of the action as required by NEPA*."[102]

CEQ's regulations establish specific ways agencies must analyze proposed actions, including project-level decisions, including a detailed discussion of direct, indirect, and cumulative impacts and their significance; and an analysis of reasonable alternatives to the proposed action. Such analysis is required for both environmental assessments and EISs.

Adaptive management

"Adaptive management" is an iterative process by which a decisionmaker sets clearly defined and measurable goals, conducts monitoring to assess whether they are being met, and then makes appropriate management changes where the desired outcomes are not being achieved.[103]

Science-based adaptive management involves "*treating management interventions as experiments, the outcomes of which are monitored and fed back into management planning.*"[104]

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[97] *New Mexico ex rel Richardson*, 565 F.3d at 706.

[98] *Id*. at 707.

[99] *Id*.

[100] *WildEarth Guardians v. Mont. Snowmobile Ass'n*, 790 F.3d 920, 925 (9th Cir. 2015).

[101] *N. Plains Res. Council, Inc. v. Surface Transp. Bd.*, 668 F.3d 1067, 1075 (9th Cir. 2011) (citation omitted).

[102] *Great Basin Mine Watch v. Hankins*, 456 F.3d 955, 973 (9th Cir. 2006).

[103] *See, e.g.*, U.S. Dep't of the Interior, Coordinating Adaptive Management and National Environmental Policy Act (NEPA) Processes (Jan. 7, 2013), available at https://www.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/ESM13-11.pdf.

Essentially, as outlined by land management experts, an adaptive management approach to forest management should include the following:[105]

- Creation of management strategies (specific action alternatives in this case)
- Implementation of those strategies/actions
- Monitoring of the effects (under the monitoring framework developed as part of the planning process)
- Predetermined triggers for changes in management based on the results of monitoring

Forest Service experts in adaptive management have said that "[a]*daptive management requires explicit designs that specify problem-framing and problem-solving processes, documentation and monitoring protocols, roles, relationships, and responsibilities, and assessment and evaluation processes*."[106]

The fourth component is described by adaptive management experts in the following statement:

> "*The term trigger, as used here, is a type of pre-negotiated commitment made by an agency within an adaptive management or mitigation framework specifying what actions will be taken if monitoring information shows x or y. In other words, predetermined decisions, or more general courses of action, are built into an adaptive framework from the beginning of the process.*"[107]

In many projects the Forest Service often states repeatedly that it will rely heavily on monitoring and adaptive management to ensure that a project meets its goals without significantly harming key resources. Unfortunately, the Forest Service usually provides almost no details about its monitoring plan, and nothing at all about what will trigger changes in project design through so-called "adaptive management."

One recent example is the South Sacramento Restoration Project on the Lincoln National Forest where the Forest Service did not identify a specific monitoring plan, and made clear that it wouldn't develop a plan until after the agency completed its NEPA review and after it approved the project. The Draft EIS for that project stated that "*Monitoring would follow the established*

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[104] Gillson, L., T.P. Dawson, S. Jack, and M.A. McGeoch. 2013. Accommodating climate change contingencies in conservation strategy. Trends in Ecology & Evolution 28(3): 135-142.

[105] Schultz, C. and M. Nie. 2012. Decision-making triggers, adaptive management, and natural resources law and planning. *Natural Resources Journal* 52:443-521.

[106] Page 58 in Stankey, G.H., R.N. Clark, and B.T. Bormann. 2005. Adaptive management of natural resources: theory, concepts, and management institutions. Gen. Tech. Rep. PNW-GTR-654. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 73 p.

[107] Id at 455

monitoring plan written during the site-specific prescription development," which would not occur until after the Project is approved.

Of primary concern is that by doing this the Forest Service will thus make it impossible for the public to review any monitoring plan unless they are involved in prescription development, which is highly unlikely. Furthermore, Forest Service decisionmakers will not know what values, if any, the agency intends to evaluate before approving this decision. Not to mention that neither decisionmakers nor the public will have any idea of who will monitor, when they will do it, or what metrics will be assessed, or how it will be funded (if at all).

In the specific case of the South Sacramento Restoration Project, this was a surprise given the amount of attention throughout the life of that project to implementing treatments within an experimental framework.

Federal courts have found agencies violated NEPA or the ESA where, like the South Sacramento Restoration Project, the agency relies on an "adaptive management" plan that is too vague, sets no specific triggers for future action, fails to describe that future action, and fails to ensure that resource will be protected as the adaptive management plan asserts. Reliance on an adaptive management plan to achieve desired conditions also appears to violate the National Forest Management Act because amendments to a Forest Plan may not ensure the protection of values identified in the 2012 forest planning rule.

In *Natural Resources Defense Council v. U.S. Army Corps of Engineers*, 457 F. Supp. 2d 198 (S.D.N.Y. 2006), the court found that the Army Corps attempt to supplement an inadequately-explained finding of no significant impact concerning a dredging project was arbitrary and capricious where the agency relied on ill-defined "adaptive management" protocols to conclude that impacts would be mitigated.

> "*The EA makes several promises that it will alter its monitoring plan should it prove necessary. For example, the EA relies on a general promise that it will "as appropriate, reevaluate, the need for altering its dredging methods" ... through the use of its coordination plan and monitoring program. The EA also explains that the Corps will follow "adaptive management practices as it moves through construction of its contracts," thus allowing it to change future contracts should the data indicate it is necessary. These promises, however, provide no assurance as to the efficacy of the mitigation measures. The Corps did not provide a proposal for monitoring how effective "adaptive management" would be*."[108]

In another case, the judge set aside a Forest Service decision to open motor vehicle trails where the agency proposed to monitor impacts to wildlife and potentially change the trails later based on an adaptive management plan. The court stated that these adaptive management strategies "*amount ... to a 'build-first, study later' approach to resource management. This backward-looking decision making is not what NEPA contemplates*."[109]

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[108] *NRDC v. United States Army Corps of Eng'rs*, 457 F. Supp. 2d at 234 (citations omitted).

[109] *Mountaineers v. United States Forest Serv.*, 445 F. Supp. 2d at 1250.

While some courts have upheld less than precise monitoring or adaptive management plans, they have done so largely where the NEPA analysis at issue was programmatic in nature and where the agency would be required to comply with NEPA, and thus re-assess mitigation, at a later stage when more site-specific data was available. *See, e.g.*, *San Juan Citizens Alliance v. Stiles*, 654 F.3d 1038, 1055 (10th Cir. 2011) (agreeing with case that held the development of more specific mitigation measures was not required at the "early stage of a multi-step process"). Other cases similarly conclude that NEPA forbids the use of ill-defined adaptive management plans cannot be used to assume away likely impacts of agency action.[110]

Courts also find unlawful agency projects that may impact species protected by the Endangered Species Act where the biological opinion is based on the assumption that a vague and ill-defined monitoring and adaptive management plan will somehow mitigate impacts to the species at issue. *Natural Resources Defense Council v. Kempthorne*, 506 F. Supp. 2d 322 (E.D. Ca. 2007) is a key precedent. There, plaintiffs challenged a proposed plan to manage water diversions in a manner that could adversely impact the delta smelt, a species listed as threatened under the Endangered Species Act. The Fish and Wildlife Service prepared a biological opinion (BiOp) on the proposal which concluded that the project would neither jeopardize the smelt nor adversely modify the smelt's critical habitat. "*Although the BiOp recognize[d] that existing protective measures may be inadequate, the FWS concluded that certain proposed protective measures, including ... a proposed 'adaptive management' protocol would provide adequate protection.*"[111]

Plaintiffs alleged, among other things, that the BiOp "*relie*[d] *upon uncertain (and allegedly inadequate) adaptive management processes to monitor and mitigate the* [project's] *potential impacts*."[112] They asserted that the adaptive management plan, which required a working group meet and consider adaptive measures in light of monitoring, failed to meet the ESA's mandate that mitigation be

> "'*reasonably specific, certain to occur, and capable of implementation'" because: (1) the [working group] has complete discretion over whether to meet and whether to recommend mitigation measures; (2) even if the [working group] meets and recommends mitigation measures, the [agency management team] group is free to reject any recommendations; (3) there are no standards to measure the effectiveness of actions taken; (4) reconsultation is not required should mitigation measures prove ineffective; and (5) ultimately, no action is ever required*.[113]

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[110] *See, e.g., High Sierra Hikers Association v. Weingardt*, 521 F. Supp. 2d 1065, 1090-91 (N.D. Ca. 2007) (overturning a Forest Service decision to liberalize the rules limiting campfires in high country parts of a wilderness area on the grounds that the agency could not rely on adaptive management to overcome an inadequate response to the problems raised in the record).

[111] *NRDC v. Kempthorne*, 506 F. Supp. 2d at 333-34 (emphasis in original).

[112] *NRDC v. Kempthorne*, 506 F. Supp. 2d at 329.

[113] *NRDC v. Kempthorne*, 506 F. Supp. 2d at 352. See also id. at 350 (explaining the "certain to occur" standard and citing *Ctr. for Biological Diversity v. Rumsfeld*, 198 F. Supp. 2d 1139, 1152 (D. Ariz. 2002)).

The *Kempthorne* court cited prior caselaw holding that "*a mitigation strategy* [in the ESA context] *must have some form of measurable goals, action measures, and a certain implementation schedule; i.e., that mitigation measures must incorporate some definite and certain requirements that ensure needed mitigation measures will be implemented.*"[114] The court found that adaptive management plan "*does not provide the required reasonable certainty to assure appropriate and necessary mitigation measures will be implemented.*"[115] The court concluded that

> "*Adaptive management is within the agency's discretion to choose and employ, however, the absence of any definite, certain, or enforceable criteria or standards make its use arbitrary and capricious under the totality of the circumstances*."[116]

Considering the range of interested and qualified stakeholders involved in this Project, we are cautiously optimistic that a robust and effective adaptive management and monitoring plan will be crafted.

Recommendations for the issue of conditions based management, adaptive management, and monitoring:

► In the Santa Fe Mountains Landscape Resiliency Project, the Forest Service should pay careful attention to disclose what adaptive management measures it might adopt, how such measures might mitigate the project's impacts, or what the impacts could be absent adoption of those measures. Any Forest Service reliance on an adaptive management without these elements clearly described would be arbitrary and capricious.

► In the Santa Fe Mountains Landscape Resiliency Project, the Forest Service should pay careful attention to avoid making the same mistakes as the plan in the *Kempthorne* case; for example, if monitoring relies on annual meetings of an interdisciplinary team, if the agency provides no standards to measure the effectiveness of "adaptive" actions, and if nothing requires the Forest Service to take any action on its monitoring data.[117]

► In the Santa Fe Mountains Landscape Resiliency Project the monitoring and adaptive management plan must contain "*definite, certain, or enforceable criteria or standards*." Looking forward, if the BiOp for the Project relies in any way on an insufficient adaptive management plan, it would also likely be struck down in court.

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[114] *NRDC v. Kempthorne*, 506 F. Supp. 2d at 355, citing *Rumsfeld*, 198 F. Supp. 2d at1153.

[115] *NRDC v. Kempthorne*, 506 F. Supp. 2d at 356.

[116] *NRDC v. Kempthorne*, 506 F. Supp. 2d at 387.

[117] Because no BiOp has been prepared for the Project, it is as yet unclear how that document will incorporate or address any adaptive management plan.

ISSUE 6: IDENTIFICATION OF AND TREATMENTS IN ROADLESS AND UNROADED AREAS.

Roadless lands are ecologically important and play a critical role in ensuring the persistence of species, providing connectivity, and ensuring watershed functionality, which is only more important in light of climate change. They also can be important for providing nature-based non-motorized recreational experiences, which are very popular in and around Santa Fe.

The Project should maintain and restore roadless and unroaded lands, including inventoried-but-not-recommended and not-yet-inventoried lands. Maintaining and enhancing the roadless character of these lands will contribute to the achievement of the substantive provisions in sections 219.8, 219.9, and 219.10 of the 2012 planning rule, ensuring that the Project does not prematurely foreclose decisions in the current plan revision.

Forest Service roadless lands are heralded for their conservation values. Those values are described at length in the preamble of the Roadless Area Conservation Rule (RACR)[118] and in the Final Environmental Impact Statement (FEIS) for the RACR.[119] They include: high quality or undisturbed soil, water, and air; sources of public drinking water; diverse 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., uncommon geological formations, unique wetland complexes, exceptional hunting and fishing opportunities).

Roadless lands are also responsible for high quality water and watersheds. Anderson and others[120] assessed the relationship of watershed condition and land management status, and found a strong spatial association between watershed health and protective designations. DellaSala and others[121] found that undeveloped and roadless watersheds are important for supplying downstream users with high-quality drinking water, and that developing those watersheds comes at significant costs associated with declining water quality and availability. Protecting and connecting undeveloped areas is also an important action agencies can take to enhance climate change adaptation and resiliency.

[118] 66 Fed. Reg. at 3245-47.

[119] Final Environmental Impact Statement, Vol. 1, 3–3 to 3–7, available at http://www.fs.usda.gov/roaddocument/roadless/2001roadlessrule/finalruledocuments.

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

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

The Roadless Rule states:

> (a) Timber may not be cut, sold, or removed in inventoried roadless areas of the National Forest System, except as provided in paragraph (b) of this section.
>
> (b) Notwithstanding the prohibition in paragraph (a) of this section, timber may be cut, sold, or removed in inventoried roadless areas if the Responsible Official determines that one of the following circumstances exists. The cutting, sale, or removal of timber in these areas is expected to be infrequent.
>
> (1) The cutting, sale, or removal of *generally small diameter timber* is needed for one of the following purposes and will maintain or improve one or more of the roadless area characteristics as defined in § 294.11.
>
> (i) To improve threatened, endangered, proposed, or sensitive species habitat; or
>
> (ii) To maintain or restore the characteristics of ecosystem composition and structure, such as to reduce the risk of uncharacteristic wildfire effects, within the range of variability that would be expected to occur under natural disturbance regimes of the current climatic period.[122]

Thus, any proposed treatments can only take place within the any IRA if the Forest Service can demonstrate that:

- The project is an "infrequent" occurrence on roadless forest; and
- The project generally logs small diameter timber; and
- The project meets the exception's purpose (improving threatened, endangered, proposed, or sensitive species habitat, or maintaining or restoring the characteristics of ecosystem composition and structure); and
- The project "*maintain*[s] *or improve*[s] *one or more of the roadless area characteristics.*"[123]

The rule defines "*roadless area characteristics*" to include:

> (1) High quality or undisturbed soil, water, and air;
>
> (2) Sources of public drinking water;
>
> (3) Diversity of plant and animal communities;

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[122] 36 C.F.R. § 294.13.

[123] *See Alliance for the Wild Rockies v. Krueger*, 950 F. Supp. 2d 1196, 1214 (D. Mont. 2013), affirmed on other grounds, 663 Fed. Appx. 515 (9th Cir. Nov. 1, 2016).

(4) Habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land;

(5) Primitive, semi-primitive nonmotorized and semi-primitive motorized classes of dispersed recreation;

(6) Reference landscapes;

(7) Natural appearing landscapes with high scenic quality;

(8) Traditional cultural properties and sacred sites; and

(9) Other locally identified unique characteristics."[124]

Recommendations for the issue of identification of and treatments in roadless and unroaded areas:

The scoping document (p. 12) makes clear that "*No new roads or temporary roads would be constructed*" and that up to 20 miles of roads would be decommissioned. We applaud the Forest Service for proposing a project that does not require new roads, either temporary or permanent. This is a very rare proposal in this regard.

Any subsequently prepared NEPA document must:

►Disclose whether and how hand or mechanical treatments will comply with the Roadless Rule.

►Disclose the impacts of hand or mechanical treatments to roadless characteristics.

►Disclose as well as analyze impacts to unroaded lands that the Forest Service does not classify as inventoried roadless areas but may be under analysis in the current plan revision.

►Identify any Forest Plan direction upon which any proposed action may rely on for direction concerning roadless areas.

► Include for analysis the Center's proposed alternative which would implement a more ambitious road closure and decommissioning program.

ISSUE 7: LOCALLY SPECIFIC REFERENCE CONDITIONS ARE NEEDED

General Technical Report 310 (Reynolds et al. 2013[125]) is cited as a primary source for formulating desired conditions for the Santa Fe Mountains Landscape Resiliency Project. We

[124] 36 C.F.R. § 294.11

[125] Reynolds, R.T., A.J. Sánchez Meador, J.A. Youtz, T. Nicolet, M.S. Matonis, P.L. Jackson, D.G. DeLorenzo and A.D. Graves. 2013. *Restoring Composition and Structure in Southwestern Frequent-Fire Forests: A*

have considerable concerns with GTR-310 because it generalizes desired conditions for the entire southwest region based off of reference site studies that were predominantly completed around Flagstaff. Desired conditions for dry conifer forests provided in GTR-310 are not specific to the Santa Fe National Forest, and should be critically reviewed prior to assuming they are applicable to the Project.

The authors of GTR-310 admit the need for developing site-specific guidance:

> "*Management informed by reference conditions and natural ranges of variability (the range of ecological and evolutionary conditions* ***appropriate for an area)*** *allow for the restoration of the characteristic composition, structure, spatial pattern, processes, and functions of ecosystems*"[126]

Disturbance patterns are driven by spatial and temporal variation in climate, vegetation growth habitats, and management history. These are place-specific and cannot reliably be generalized over broad landscapes or timeframes.[127/128] Ecologists stress definition of locally specific reference conditions to justify restoration goals and outcomes due to scale dependence of ecological pattern.[129/130/131] For example, Korb and others[132] stated this about their study results from the San Juan Mountains of southern Colorado:

> "*Our findings demonstrate the need to develop site-specific reference conditions and for managers to exercise caution when extrapolating fire regimes and forest structure from one geographic locality to another given a projected warmer climate making conditions more favorable to frequent, large wildfires*."

Science-Based Framework for Improving Ecosystem Resiliency. USDA For. Serv. Rocky Mtn. Res. Sta. Gen. Tech. Rep. RMRS-GTR-310. Fort Collins, CO.

126 Page 2 in Reynolds et al. 2013 (emphasis added)

127 Agee, J.K. 1996. The influence of forest structure on fire behavior. Pp. 52-68 in: J.W. Sherlock (chair). *Proc. 17th Forest Vegetation Management Conference.* 1996 Jan. 16-18: Redding, CA. Calif. Dept. Forestry and Fire Protection: Sacramento.

128 DellaSala, D.A., J.E. Williams, C.D. Williams and J.F. Franklin. 2004. Beyond smoke and mirrors: a synthesis of fire policy and science. *Conservation Biology* 18: 976-86.

129 Noss, R., P. Beier, W. W. Covington, R. E. Grumbine, D. B. Lindenmayer, J. W. Prather, F. Schmiegelow, T. D. Sisk, and D. J. Vosick. 2006. Recommendations for integrating restoration ecology and conservation biology in ponderosa pine forests of the Southwestern United States. *Restoration Ecology* 14: 4-10.

130 Swetnam, T.W., C.D. Allen and J.L. Betancourt. 1999. Applied historical ecology: Using the past to manage the future. *Ecological Applications* 9(4):1189-1206.

131 White, P.S. and J.L. Walker. 1997. Approximating nature's variation: selecting and using reference information in restoration ecology. *Restoration Ecology* 5: 338-349.

132 Korb, J.E., P.Z. Fule, P.Z. and R. Wu. 2013. Variability of warm/dry mixed conifer forests in southwestern Colorado, USA: Implications for ecological restoration. *Forest Ecology and Management* 304:182-191.

We reviewed the 111 studies cited in GTR-310 as sources of information for reference conditions, disturbance histories, disturbance effects, stand structure and composition, and canopy openness. These studies are listed by location in a table and a map on the following pages.

It's vitally important for planners at the Santa Fe National Forest to recognize that none of the reference studies cited in GTR-310 were from the Sangre de Cristo Mountains, and the two locations in the Jemez Mountains on the Santa Fe National Forest amount to approximately 12 acres of sampled forest.

If you search GTR-310 for the name "Santa Fe" you will not find it. The information used in GTR-310 to craft regionally generalized desired conditions for ponderosa pine and mixed conifer forest is derived mainly from valid and vetted studies completed *more than 200 miles from the Project*. Because of the reliance on sites predominantly around Flagstaff, and a near-total lack of study sites anywhere on the Santa Fe National Forest, GTR-310 has limited applicability to the Project. Please, Santa Fe, pay close attention to this.

The Project landscape is unique in its elevational gradient and topographic position, and it bears little resemblance to the Flagstaff area. Weather and climate in the Sangre de Cristo's is not the same as Flagstaff. A compilation and averaging of sites surrounding Flagstaff is not a surrogate for locally-derived information specific to the southern Rocky Mountains.

GTR-310 promulgates the "Flagstaff Model" of forest restoration and relies on recurring mechanical interventions

GTR-310 is the Forest Service's own self-published desired conditions for dry conifer forest in the southwest and we believe it was intentionally designed to implement the "Flagstaff Model" of forest restoration across the southwest. We believe that the Forest Service crafted GTR-310 based on the Flagstaff Model because the lower densities and more "open, park-like" conditions typical to the Flagstaff area would allow the Forest Service to apply more intensive logging treatments in areas where stands were historically more dense and closed-canopy than around Flagstaff.

In essence GTR-310 is scientific is cover for "getting the cut out."

Close inspection of place-specific information reveals that Reynolds and others selectively interpreted literature to make their case for sustained mechanical intervention as a surrogate for restoration of natural fire regimes. In GTR-310, Reynolds and others (p. 48-49) state:

> "*The re-establishment of frequent, low-severity fire is critical to the success of our restoration framework. However, because of limitations such as proximity to human developments, air quality restrictions, and workforce capacity, the use of fire will probably continue to be limited. Therefore, mechanical-only treatments, or perhaps combinations of fire and mechanical treatments, are likely to be the restoration tools of choice in much of the Southwestern landscape… Yields between 400 and 700 cubic ft per acre seem reasonable from a cutting cycle of 25 to 30 years once restoration achieves an approximate balance of structural stages in frequent-fire forests*."

That statement is the sole basis presented by the authors for their recommendation of landscape-scale mechanical treatments of vegetation in ponderosa pine and mixed conifer forest. Contrary to their assessment, we would argue that workforce limitations will affect mechanical thinning operations more than fire management crews. GTR-310's "implementation recommendations" (p. 35-37) do not present a compelling fact-based case for the efficacy of mechanical treatments to manage structure or composition in fire-adapted forest, other than to allude that such treatments may be desirable for unstated reasons, perhaps including "getting the cut out."

GTR-310 Uncertain of Desired Conditions in Mixed Conifer Forest

In GTR-310, Reynolds and others (p. 12) admit uncertainty in their recommendation of desired conditions for dry conifer forest resulting from a paucity of supporting information and geographic imbalance of accessible data:

> "*There is a clear need for additional reference condition data sets, including sites from a wider spectrum across environmental gradients (e.g., soils, moisture, elevations, slopes, aspects) occupied by frequent-fire forests in the Southwest, especially in dry mixed-conifer. While the quantity of reference data sets is increasing, existing data represent a largely unbalanced sampling across gradients (e.g., most data sets are from basaltic soils and on dry to typic plant associations), and there have been few studies quantitatively*."

In this statement, the authors of GTR-310 admit a bias towards the studies completed on basaltic soils in drier sites, in other words: the Flagstaff model.

The GTR-310 approach to uncertainty is to blur site-specific forest variation across a vast geographic area and *scale up* desired conditions to broad landscapes with a generic "*pooled natural range of variability*"[133]:

> "*The natural range of variability can be estimated by pooling reference conditions across sites within a forest type. Reference conditions for a forest type typically vary from site to site due to differences in factors such as soil, elevation, slope, aspect, and micro-climate and manifests as differences in fire effects, tree densities, patterns of tree establishment and persistence, and numbers and dispersion of snags and logs. When pooled, these sources of variability comprise the natural range of variability of a site or forest type*."

Pooling reference conditions would be appropriate if there was even geographic distribution of reference sites, but as we are proving here, the Project area is in no way included in the sites that were pooled in GTR-310.

Most Reference Studies in GTR-310 Are Silviculture Plots in the Flagstaff Area

It is true that in GTR-310 Reynolds and colleagues synthesized a wide array of very high quality scientific literature, as well as some very interesting historical Forest Service timber research

[133] Reynolds et al. 2103: p. 11

documents. However, the studies used to substantiate the GTR-310 structural framework are disproportionately clustered around northern Arizona, including a number of studies at the same sites (Gus Pearson Natural Area and Fort Valley Experimental Forest). GTR-310 also places an emphasis on plot re-measures of the historic "Woolsey plots", which are not representative of the surrounding landscape.[134]

Much of GTR-310 is based on reconstruction studies of "Woolsey Plots." In 1909, T.S. Woolsey, Jr., Assistant District Forester and Chief of the Office of Silviculture (Southwestern District now Southwest Region 3), and G. A. Pearson, Director, Fort Valley Forest Experiment Station (Flagstaff, AZ), drafted instructions that led to establishment of a network of permanent plots in ponderosa pine, mixed conifer, and spruce-fir forests of the Southwest. Between 1909 and 1941 Woolsey and team established 140 plots in AZ and NM, of which 98 were in ponderosa pine. Of the pine plots, 30% are located southwest of Flagstaff at the Coulter Ranch site. Of the 140 plots, 44 were in the Coconino NF. These studies are the basis of GTR-310. A researcher from Flagstaff said this about the Woolsey Plots:

> "*So-called sample plots were established on logged over areas in order to ascertain how fast residual stands would grow, whether they could produce merchantable timber, and whether natural restocking would take place.*"[135]

Bell and others[136] compared current conditions of 14 Woolsey plots to 98 AZCFI and 58 FSFIA plots in the Flagstaff/western Mogollon Rim area. The metrics under comparison were Trees/Hectare, BA/Hectare, QMD, and frequency of DBH classes/hectare. Comparisons of forest structural data applied a distance-based multivariate nonparametric permutation method. All analyses indicated dissimilarity between the FIA and CFI plots compared to the Woolsey plots across the study area, and across TEU's. Within TEU's, the Woolsey plots were not statistically dissimilar, but current conditions were consistently denser in all metrics. Bell and colleagues results suggest that Woolsey plots are only representative of the TEU to which the plot belongs:

> "*The selection of [Woolsey] plot locations in the early 1900s followed a subjective nonrandom approach. [Our] results indicated that the Woolsey plots (1) were neither historically nor contemporarily representative of the entire study area because of environmental and current forest structural differences with respect to the FSFIA and AZCFI and (2) may be considered historically representative of their corresponding TEUs. Our study supports the use of TEUs for defining the applicability of information obtained from the Woolsey plots….Subjective plot selection, together with the small sample size of this rare*

[134] The reconstructions by ERI scientists on Woolsey plots have established a high bar for scientific integrity, but the plots were subjectively located by Woolsey and team as part of early silvicultural experiments, calling the usefulness of the results to be interpreted carefully and within a broader collection of multiple lines of evidence on representative sites.

[135] Page 272 in Pearson, G. A. 1933. A twenty-year record of changes in Arizona pine forest. Ecology 4:272–285.

[136] Bell, D.M., P.F. Parysow, and M.M. Moore. 2009. Assessing the representativeness of the oldest permanent inventory plots in northern Arizona ponderosa pine forests. *Restoration Ecology* 17(3): 369-377.

> *dataset, raises questions about the inference space with regard to the larger, heterogeneous landscape of ponderosa pine forests in northern Arizona.*"[137]

Woolsey and team surveyed a mere six plots on the Santa Fe National Forest, but one-third of those historic plots and accompanying data have not been discovered.[138]

Based on these findings, Woolsey plots (which are the underpinning of GTR-310) are not representative in any way of the Sangre de Cristo Mountains, calling into question the usefulness of GTR-310 for the Santa Fe Mountains Landscape Resiliency Project.

The densest single hectare of forest on the Bluewater demonstration site, where GTR-310 came to life.

Is this what you want for the Santa Fe Mountains?

Photo by Joe Trudeau, June 2017

137 Page 369 in Bell et al. 2009.

138 Moore, M.M., D.W. Huffman, J.D. Bakker, A.J. Sanchez Meador, D.M. Bell, P.Z. Fulé, P.F. Parysow, and W.W. Covington. 2004b. Quantifying Forest Reference Conditions for Ecological Restoration: The Woolsey Plots. *Final Report to the Ecological Restoration Institute for the Southwest Fire Initiative.* School of Forestry & Ecological Restoration Institute, Northern Arizona University, Flagstaff, AZ.

FIGURE 1: LOCATIONS OF CERTAIN REFERENCE SITES* USED IN GTR-310 (REYNOLDS ET AL., 2013)

*Specifically Tables 3, 6 and 9

Sites referenced by Reynolds et al (2013) are biased towards conditions at the Grand Canyon and Mogollon Plateau around Flagstaff. All sites shown for New Mexico are limited to original inventory by Woolsey (1909-1913) and subsequent re-measures of those sites (Moore et al. 2004). Polygons represent work by Abella and Denton (2009; square around Flagstaff) and Williams and Baker (2012; two polygons along Mogollon Rim). None of the studies assessed in GTR-310 include sites with ponderosa pine-evergreen oak or ponderosa pine-shrub types.

"*The minimum diameters reported in Table 6 may also result in a source of error that can lead to small underestimates of historical tree densities reported in studies. Additional error may result from missing fully decomposed structures at time of measurement and reconstruction*" (Reynolds et al., 2013: p.17).

"*To date, only six studies report tree spatial reference conditions in the Southwestern ponderosa pine forests*" (Reynolds et al., 2013: p.17).

"*Management informed by reference conditions and natural ranges of variability (the range of ecological and evolutionary conditions* ***appropriate for an area****) allow for the restoration of the characteristic composition, structure, spatial pattern, processes, and functions of ecosystems*" (Reynolds et al., 2013: p.2, emphasis added).

"Some dry mixed-conifer forests and ponderosa pine-shrub communities experienced mixed-severity fires, which included combinations of surface and crown fires, sometimes resulting in larger patches of tree aggregation" (Reynolds et al., 2013: p.1).

Figure 2: Locations Of Studies Cited In Reynolds et el. (2013) *see GTR-310 for full citations	
General Location of Referenced Literature	**Literature cited for that location in GTR-310** **Bold** denotes measurements at historic Woolsey plots <u>Underline</u> denotes study specific to Gus Pearson Natural Area, Coconino NF
New Mexico	**Moore et al., 1994 (Gila & Zuni Mtns Woolsey remeasures); Woolsey, 1911 (Carson, Zuni, Gila, Alamo, Jemez sites);** Allen, 2007 (northern NM); Brown et al., 2001 (Sacramento Mountains); Conklin & Geils, 2008 (Jemez & Manzano Mountains); Kaye & Swetnam, 1999 (Sacramento Mountains); Negron, 1997 (Sacramento Mountains); Romme et al., 1999 (Carson & Santa Fe NF's); Swetnam & Dieterich, 1985 (Gila Wilderness); Touchan et al., 1996 (Jemez Mountains)
North Rim Grand Canyon/Kaibab Plateau/Uinkaret Plateau	Covington & Moore, 1994; Fule et al., 2002; Fule et al., 2003; Fule & Laughlin, 2007; Heinlein et al., 1999; Lang & Stewart, 1910; Rasmussen, 1941; Roccaforte et al., 2010; Waltz & Fule, 1998; White & Vankat, 1993
South Rim Grand Canyon	Fule et al., 2002; Harrington & Hawksworth, 1980; **Woolsey, 1911**
Mogollon Plateau (Flagstaff Area)	Abella & Denton, 2009; Abella et al., 2011; <u>Biondi et al., 1994; Biondi, 1996;</u> Cocke et al., 2005; <u>Covington & Sacket, 1986;</u> Covington & Moore, 1994a&b; <u>Covington et al., 1997</u>; Dieterich, 1980; Fule et al., 1997; Heinlein et al., 2005; Hoffman et al., 2007; <u>Mast et al., 1999;</u> Menzel & Covington, 1997; <u>Pearson, 1950; White, 1985;</u> **Sanchez Meador et al., 2011; Sanchez Meador & Moore, 2010; Woolsey, 1911;** Schneider, 2012; Williams & Baker, 2012
Mogollon Rim (Apache-Sitgreaves NF, White Mtn. Apache Reservation)	Cooper, 1960, 1961; Greenamyre, 1913; Lynch et al., 2010; Williams & Baker, 2012; **Woolsey, 1911**
Colorado	Binkley et al., 2008 (Uncompahgre Plateau); Boyden et al., 2005 (Front Range); Brown & Wu, 2005 (SW of Pagosa Springs); Ehle & Baker, 2003 (RMNP); Fornwalt et al., 2002 (Front Range); Fule et al., 2009 (San Juan Mountains); Grissino-Mayer et al., 2004 (San Juan Mountains); Korb et al., 2012 (San Juan Mountains); Mast et al., 1998 (Front Range); Mast & Veblen, 1999 (Front Range); Romme et al., 1999 (SW Colorado)
Southwestern Utah	Madany & West (Zion National Park)
Pacific and Inland Northwest/Northern Rocky Mountains/Black Hills (South Dakota)	Agee, 2003; Arno et al., 1995; DeLuca & Sala, 2006; Franklin et al., 2002 (incorrectly cited as 2012); Harrod et al., 1999; Hessberg et al., 1994, 2004, 2005; Lundquist, 1995; Nacify et al., 2010; Taylor, 2010; Taylor & Skinner, 2003; Von Schrenck, 1903; West, 1969; Wickman, 1963; Youngblood et al., 2004
Mexico/Baja California	Minnisch et al., 2000; Stephens et al., 2008
California	Fettig, 2012; Parsons & DeBenedetti, 1979 (Sequoia & Kings Canyon NP); Scholl & Taylor, 2010 (Yosemite NP)
Sky Islands Region	Barton, 2002; Grissino-Mayer et al., 1995
Illinois	Dhillon & Anderson, 1993
Macro-scale studies (west-wide/regional) * denotes utilization of Gila NF data	Bentz et al., 2010; Drummond, 1982; Littell et al., 2009; Maffei & Beatty, 1988; Moeck et al., 1981; Negron et al., 2009; Swetnam & Baison, 1996*; Savage & Mast, 2005*; Swetnam & Betancourt, 1990*; Wood, 1983
Review Reports, books, or general literature inappropriately cited as reference-site studies or original research	Abella, 2008; Abella, 2009; Castello et al., 1995; Edmunds et al., 2000; Ferry et al., 1995; Fitzgerald, 2005; Friederici, 2004; Goheen & Hansen, 1993; Hart et al., 2005; Hawksworth & Weins, 1996; Jenkins et al., 2008; Larson & Churchill, 2012; Miller & Keen, 1960; Miller, 2000; Rippy et al., 2005; Smith, 2006a,b,c; Stevens & Hawksworth, 1984; Tainter & Baker, 1996; Weaver, 1950

GTR-310 Excludes Reference Sites that Corroborate Occurrence of Higher Density Forests in the Southwest than the Forest Service Wants to Admit

Some important historical reference sites were notably excluded from GTR-310, such as the Long Valley Experimental Forest, which was established in 1936 as a comparison site to the much-studied Fort Valley unit. Long Valley "*contained some of the best stands of ponderosa pine on the Coconino and Sitgreaves National Forests*"[139] but for an unknown reason it does not appear in GTR-310. The regional desired conditions document does mention the Long Valley site noting that:

> "*On the Long Valley Experimental Forest (sedimentary soils on the Mogollon Rim, central Arizona), the sampled trees per acre (1938) ranged up to 99 trees per acre, with an estimated 75 trees per acre being present prior to the cessation of frequent fire (circa 1880-1900, USDA Forest Service, unpublished data from Long Valley Experimental Forest).*"[140]

If the pre-settlement trees per acre value (~75TPA) was included in GTR-310, it would have been more dense than any other ponderosa pine reference site cited in Arizona, with the exception of the Grand Canyon sites studied by Fule and colleagues[141] or the Malay Gap site studied by Cooper.[142]

Why does the Forest Service ignore Long Valley's dense forest in GTR-310? The only site included in GTR-310 that is denser Long Valley is Malay Gap, studied by Cooper. Coopers Malay Gap study area pushes the limits for density metrics reported in GTR-310, but surprisingly this site was in fact not even as dense as Coopers Maverick study site that, like Long Valley, was not included in GTR-310. Long Valley may have been even denser than Maverick, assuming that not all of the remaining 24 post-fire suppression trees would have been killed by fire. In addition, Long Valley's densities, if reported in GTR-310, would have been essentially equal to Williams and Bakers studies along the Mogollon Rim which have been widely criticized by the restoration community for inference of high severity fire.[143]

Lessons from Coopers Seminal 1960 Reference Site Study

Cooper studied three sites on the White Mountain and San Carlos Apache Reservations in 1957. His paper is one of the most oft-cited sources of reference conditions data and descriptions for

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[139] https://www.fs.usda.gov/main/longvalley/home

[140] Page 14 in the Southwest Region Desired Conditions Document

[141] Fulé, P.Z., W.W. Covington, M.M. Moore, T.A. Heinlein, and A.E.M. Waltz. 2002. Natural variability in forests of the Grand Canyon, USA. *Journal of Biogeography* 29:31-47.

[142] Cooper, C.F. 1960. Changes in vegetation, structure and growth of southwestern pine forests since white settlement. *Ecological Monographs* 30: 129-64.

[143] See Fule et al., 2014. "Unsupported inferences of high-severity fire in historical dry forests of the western United States: a response to Williams and Baker." *Global Ecology and Biogeography* 23:825-830.

southwestern ponderosa pine, including by GTR-310. Cooper's Bog Creek site was selectively logged in the 1930's, but his Maverick and Malay Gap sites were unlogged, the latter also having never experienced fire suppression nor livestock grazing.

Of the Malay Gap site, Cooper (p. 139) wrote "*this is perhaps the closest approach to a truly primeval forest left in the Southwest*." Prior to 1910, the Malay Gap site had experienced wildfire on average every 7 years, and then burnt again in 1910, 1919, 1935, and lastly in 1943. By the time of his field work, in 1957, the fire regime was effectively uninterrupted. Cooper's extensive report is indeed one of the most essential studies to read and comprehend, and it is important to fully examine the breadth and depth of his analyses, as well as the photographs included therein, in order to responsibly reference this detailed work.

In addition to simple density metrics, Cooper reported on spatial arrangement, age/size distributions, regeneration patterns in time and space, fire effects on stand development, and many other important ecological processes that are still being debated. Of particular relevance to the current debate in ponderosa pine restoration are his observations on the grouping habits of this species.

The concept of "interspaces" is a central tenet in the formulation of desired conditions by some within the U.S. Forest Service, wherein these "interspaces" are areas not occupied by trees and serve to define somewhat even-aged groups. The entire basis of the model promulgated in Reynolds and others is built around this notion. However, Cooper's analysis of Malay Gap might suggest that this model is not applicable to all areas. In discussing structural patterns in the virgin pine forest, he remarked (at p. 158):

"*The relatively small size of the even-aged groups in the southwestern forest is due to the small size of the openings in which the groups can become established*."[144]

It is a step backwards for restoration ecologists to dilute his work to a few numbers, such as his determination that mean basal area at Malay Gap, where a visitor "*is immediately struck by the open nature of the forest*", was 70 ft^2/acre.[145] The figure below, taken directly from Cooper (1960: p. 150), shows an image that does not support most contemporary notions of an "open" forest, and in fact might be considered overly dense by many land managers.

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[144] Cooper's report does not specifically provide data as to how many trees occur per group, but he does state (at p. 149) that "*analysis indicates that the mature stands at both Maverick and Malay Gap are aggregated into groups with an area of .16 to .32* [acres]", within the range described by Reynolds et al. (2013). However, the definition of a "group" would seem to differ greatly between the two sources based on comparison of Cooper's example photos and observations at the Bluewater demonstration site and other contemporary treatments.

[145] Interestingly, Reynolds et al. (2013) cite Malay Gap as a reference site, but ignore the results from the Maverick study location, which had a mean basal area of 102 ft^2/acre, to which Cooper (1960: p. 150) remarked: *"Although similar in basic composition and structure, the forests at Maverick and Malay Gap are quite different in appearance… The site at Malay Gap is clearly not as good as that at Maverick. The average height of mature dominants at Malay Gap is 95 ft, while those at Maverick average about 110 ft…The difference reflects inherent differences in site productivity*." The basal area of old growth at Maverick exceeds the range reported in Reynolds et al. (2013) and is outside of the basal area range given in Table 2 in the regional desired conditions document.

The figure below (Cooper, 1960: p. 148) is a typical example of the "*conspicuous… grouped arrangement of the trees*." Similarly to the figure provided on the previous page, this image again contradicts the widespread contemporary notion of what constitutes a "*distinct group*". Nowhere in his report does Cooper specify how he determined what a "group" was, but it would seem apparent that his definition is markedly different than many offered today.

PATTERN

A conspicuous feature of the ponderosa pine forest is the grouped arrangement of the trees. It is obvious that the forest is composed of distinct groups, each made up of several trees similar in size and apparent age (Fig. 17). This fact has long been recognized, but surprisingly little attention has been given to the structure of these groups or to their mode of origin.

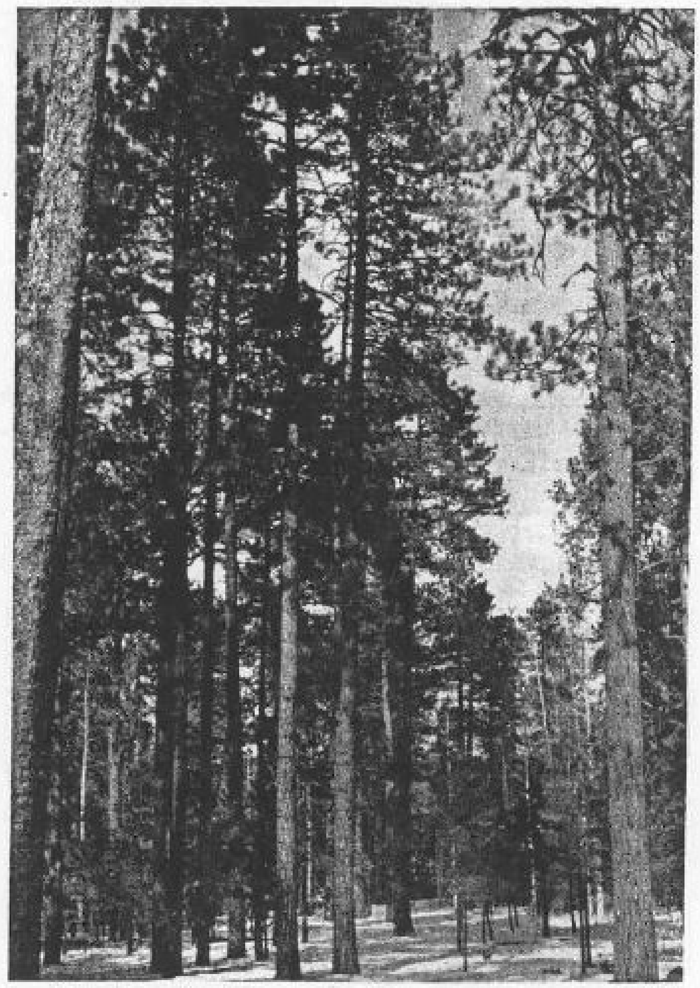

FIG. 17. Typical stand of mature ponderosa pine, showing grouped distribution of trees.

FOREST CONDITIONS AT MAVERICK AND AT MALAY GAP

Although similar in basic composition and structure, the forests at Maverick and at Malay Gap are quite different in appearance. A visitor to Malay Gap, conditioned by acquaintance with the over-dense thickets characteristic of most of the Southwestern pine region, is immediately struck by the open nature of the forest (Fig. 20). The forest floor is carpeted with a deep layer of grass, and small discrete patches of young trees are dispersed among groups of stately pines. The pure beauty of the Malay Gap region more than compensates for its difficulty of access.

FIG. 20. Typical view of the ponderosa pine forest in the primitive area at Malay Gap.

LONG VALLEY EXPERIMENTAL FOREST: 2 TO 3 TIMES DENSER THAN FORT VALLEY, BUT IGNORED BY GTR-310
Photo: Joe Trudeau, 10.11.2017 (compare to Cooper's photo on the previous page)

Recommendations for the issue of locally specific reference conditions:

The scoping document states that "*The desired conditions for this project are informed by reference conditions*." If the Santa Fe Mountains Landscape Resiliency Project is to base its desired conditions on GTR-310, then the project is lacking some significant guidance provided by other neglected reference sites and local information. Additionally, it's critical to remember that very little scientific attention has been given to determining reference conditions for the wet or dry mixed conifer forests common to the Project landscape, and there's been virtually no research on reference conditions in spruce-fir forests. The Project is not proceeding under the direction of good science without seeking to better understand reference conditions in the unique forests and woodlands of this landscape.

► At an absolute minimum, any subsequently prepared NEPA document on the Project must address the science referenced here and explain why, in the face of this contrary science, the Forest Service continues to rely on GTR-310 to guide forest treatments in the Sangre de Cristo Mountains. NEPA requires agencies to explain opposing viewpoints and their rationale for choosing one viewpoint over the other.[146] Federal courts have set aside NEPA analysis where the agency failed to respond to scientific analysis that calls into question the agency's assumptions or conclusions.[147] We trust that the Santa Fe National Forest will give substantial consideration to determining locally specific reference conditions before adopting the metrics describe din GTR-310 as desired conditions.

► A fundamental principle of southwestern forest restoration is development of site-specific reference conditions.[148] Any subsequent NEPA document needs to evaluate the applicability of GTR-310 to the Project, cross-referencing GTR-310's recommendations to specific local characterizations described sources which describe local site conditions, and if necessary, conduct additional studies to develop more accurate local reference conditions. Please list and summarize locally-specific literature describing reconstructed reference conditions.

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[146] 40 C.F.R. § 1502.9(b) (requiring agencies to disclose, discuss, and respond to "any responsible opposing view").

[147] *See Ctr. for Biological Diversity v. U.S. Forest Serv.*, 349 F.3d 1157, 1168 (9th Cir. 2003) (finding Forest Service's failure to disclose and respond to evidence and opinions challenging EIS's scientific assumptions violated NEPA); *Seattle Audubon Soc'y v. Moseley,* 798 F. Supp. 1473, 1482 (W.D. Wash. 1992) ("The agency's explanation is insufficient under NEPA – not because experts disagree, but because the FEIS lacks reasoned discussion of major scientific objections."), *aff'd sub nom. Seattle Audubon Soc'y v. Espy,* 998 F.2d 699, 704 (9th Cir. 1993) ("[i]t would not further NEPA's aims for environmental protection to allow the Forest Service to ignore reputable scientific criticisms that have surfaced"); *High Country Conservation Advocates v. Forest Service*, 52 F. Supp. 3d 1174, 1198 (D. Colo. 2014) (finding Forest Service violated NEPA by failing to mention or respond to expert report on climate impacts).

[148] Allen, C.D. M.A. Savage, D.A. Falk, K.F. Suckling, T.W. Swetnam, T. Schulke, P.B. Stacey, P. Morgan, M. Hoffman, and J.T. Klingle. 2002. Ecological restoration of southwestern ponderosa pine ecosystems: A broad perspective. *Ecological Applications* 12(5): 1418-1433.

SECTION II. PROPOSAL OF A REASONABLE ALTERNATIVE FOR ANALYSIS.

When federal agencies prepare an EIS, NEPA requires that they must take a "*hard look*" at the project's environmental impacts and the information relevant to its decision.[149] In taking the required "*hard look*," an EIS must "*study, develop, and describe*" reasonable alternatives to the proposed action.[150] This alternatives analysis "*is the heart of the environmental impact statement*."[151]

As a result, agencies must "[r]*igorously explore and objectively evaluate all reasonable alternatives*."[152] "*To comply with the National Environmental Policy Act and its implementing regulations,* [agencies] *are required to rigorously explore* <u>*all*</u> *reasonable alternatives ... and give each alternative substantial treatment in the environmental impact statement*."[153] "*Without substantive, comparative environmental impact information regarding other possible courses of action, the ability of an EIS to inform agency deliberation and facilitate public involvement would be greatly degraded*."[154]

When a federal agency prepares an EIS, it must consider "*all reasonable alternatives*" which are consistent with its stated purpose and need.[155] An agency may dismiss a reasonable alternative if it is not "'*significantly distinguishable from the alternatives already considered*.'"[156]

Federal courts have struck down Forest Service EISs where the agency evaluated several alternatives, but where those alternatives were all fairly similar. *See, e.g., California v. Block*, 690 F.2d 753, 767-69 (9th Cir. 1982) (setting aside Forest Service EIS that evaluated eight alternatives because all of the alternatives considered protecting less than 34% of eligible lands as potential wilderness).

In addition, NEPA "*does not permit the agency to eliminate from discussion or consideration a whole range of alternatives, merely because they would achieve only some of the purposes of a*

[149] *Wyoming v. U.S. Dep't of Agriculture*, 661 F.3d 1209, 1237 (10th Cir. 2011).

[150] 42 U.S.C. §§ 4332(2)(E); 4332(2)(C)(iii).

[151] 40 C.F.R. § 1502.14; *see also All Indian Pueblo Council v. United States*, 975 F.2d 1437, 1444 (10th Cir. 1992).

[152] 40 C.F.R. § 1502.14.

[153] *Custer County Action Ass'n v. Garvey*, 256 F.3d 1024, 1039 (10th Cir. 2001) (emphasis added). *See also New Mexico ex rel. Richardson v. Bureau of Land Management*, 565 F.3d 683, 703 (10th Cir. 2009) ("[A]n EIS must rigorously explore and objectively evaluate all reasonable alternatives to a proposed action, in order to compare the environmental impacts of all available courses of action."); *Colo. Envtl. Coalition v. Dombeck*, 185 F.3d 1162, 1174 (10th Cir. 1999) (explaining reasonable alternatives).

[154] *New Mexico ex rel. Richardson*, 565 F.3d at 708.

[155] 40 C.F.R. § 1502.14(a). *See also Colorado Environmental Coal. v. Salazar,* 875 F. Supp. 2d 1233, 1245 (D. Colo. 2012) (stating that the agency's objectives dictate the range of reasonable alternatives).

[156] *Colorado Environmental Coal. v. Salazar,* 875 F. Supp. 2d at 1245 (quoting *New Mexico ex rel. Richardson,* 565 F.3d 683, 708-09 (10th Cir. 2009).

multipurpose project."[157] If a different action alternative "*would only partly meet the goals of the project, this may allow the decision maker to conclude that meeting part of the goal with less environmental impact may be worth the tradeoff with a preferred alternative that has greater environmental impact*."[158]

Federal courts routinely find that agency that fail to consider reasonable middle-ground alternatives violate NEPA,[159] so we sincerely hope that our proposed alternative will receive fair consideration by the Forest Service.

The Strategic Treatments for Fire Use Alternative Framework.

USFS research scientists have long worked to develop decision support, risk management, and prioritization tools for use in applications like the current Project. Their work has been fundamental in establishing the science of optimization that is increasingly being explored and implemented in the western United States. Important considerations for utilizing wildland fire use have been identified by fire management professionals[160] and agency-developed risk management and decision support systems, such as Fire Effects Planning Framework,[161] provide systematic geospatial techniques for managing fire for resource benefit.

Ager and colleagues stated in a 2013 article that "*Meeting the long-term goals of dry forest restoration will require dramatic increases in prescribed and managed fire that burn under conditions that pose minimal ecological and social risk. Optimization models can facilitate the attainment of these goals by prioritizing management activities and identifying investment tradeoffs.*"[162] That 2013 work, located in ponderosa pine forests on the Deschutes National Forest in Oregon, studied an optimization model "*…to locate project areas to most efficiently reduce potential wildfire loss of fire resilient old growth ponderosa pine while creating contiguous areas within which prescribed and managed fire can be effectively used...*"[163] The

[157] *Town of Matthews v. U.S. Dep't. of Transp*., 527 F. Supp. 1055, 1057 (W.D. N.C. 1981).

[158] *North Buckhead Civic Assoc v. Skinner*, 903 F.2d 1533, 1542 (11th Cir. 1990). *See also Natural Resources Defense Council v. Callaway*, 524 F.2d 79, 93 (2d Cir. 1975) ("the EIS must nevertheless consider such alternatives to the proposed action as may partially or completely meet the proposal's goal and it must evaluate their comparative merits"); *Natural Resources Defense Council v. Morton*, 458 F.2d 827, 836 (D.C. Cir. 1972) ("(it is not) appropriate, as Government counsel argues, to disregard alternatives merely because they do not offer a complete solution to the problem.").

[159] See, e.g., *Wilderness Soc'y v. Wisely*, 524 F. Supp. 2d 1285, 1312 (D. Colo. 2007) (striking down BLM NEPA analysis where agency failed to analyze in detail "*a potentially appealing middle-ground compromise between the absolutism of the outright leasing and no action alternatives*.")

[160] Black *et al.* 2008. Wildland Fire Use Barriers and Facilitators. *Fire Management Today* 68(1): 10-14. Doane *et al.* 2006

[161] Black and Opperman 2005. Fire Effects Planning Framework: a user's guide. RMRS-GTR-163.

[162] p. 11 in Ager *et al.* 2013

[163] p. 3 in Ager *et al.* 2013

complex modelling and algorithms used by the researchers ultimately identified locations where strategically deployed mechanical treatments would reduce flame length and thus save old growth ponderosa pine.

One common fundamental similarity between all optimization models is that they seek to reduce fire-severity or minimize wildfire risk, balancing tradeoffs between the size of treatment units, the placement of treatments, and the proportion of the landscape treated.[164] Collins and colleagues[165] also reviewed fuel treatment strategies, including much of Finney and Ager's work, and arrived at some basic parameters for optimizing fuel reduction treatments at the landscape scale that provide some guidance for those evaluating tradeoffs and can be used as guidelines in the *Strategic Treatments for Fire Use Alternative*:

- Treating 10% of the landscape provides notable reductions in modeled fire size, flame length, and spread rate across the landscape relative to untreated scenarios, but treating 20% provides the most consistent reductions in modeled fire size and behavior across multiple landscapes and scenarios.

- Increasing the proportion of area treated generally resulted in further reduction in fire size and behavior, however, the rate of reduction diminishes more rapidly beyond 20% of the landscape treated.

- Random placement of treatments requires substantially greater proportions of the landscape treated compared with optimized or regular treatment placement.

- The improvements offered by optimized treatments are reduced when 40-50% of the landscape is unavailable for treatment due to land management constraints.

- Treatment rates beyond 2% of the landscape per year yield little added benefit.

Considering the fire modeling that we presume is already underway by the Forest Service, and the key takeaways reviewed here, we believe that a modified version of the methodology developed by the Hurteau lab and used by Krofcheck and colleagues[166] is most appropriate for this Project analysis.

Let us be clear: we hereby request formally that an alternative for analysis be concluded that represents the core principles of this Strategic Treatments for Fire Use Alternative Framework.

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[164] Collins *et al.* 2010. Challenges and approaches in planning fuel treatments across fire-excluded forested landscapes. *Journal of Forestry* Jan/Feb 2010: 24-31

Chung 2015. Optimizing fuel treatments to reduce wildland fire risk. *Current Forestry Reports* 1: 44-51.

Krofcheck *et al*. 2017a

[165] Collins *et al.* 2010

[166] Krofcheck *et al*. 2017a; Krofcheck *et al*. 2017b

The Krofcheck and colleagues optimization model, which mechanically treats only the operable areas with a high probability of mixed- and high-severity fire, was shown in multiple fire simulations to be as effective as thinning all operable acres at reducing wildfire burn severity and facilitating landscape scale low-severity fire restoration. The authors summarize their methods here:

> "*We developed three scenarios: no-management, naive placement, and optimized placement. Both management scenarios employed combinations of mechanical thinning and prescribed burning. The naive placement scenario aimed to simulate mechanical thinning from below and prescribed fire to all forest types that have experienced a fuels load departure from their historic condition due to fire exclusion. Within each forest type that received mechanical thinning, thinning was constrained based on operational limits (slope>30%, which totaled 22,436 ha available for mechanical thinning). The optimized placement scenario further constrained the area that received mechanical thinning by limiting thinning to areas that also had a high probability of mixed- and high-severity wildfire…In both treatment scenarios, stands identified for mechanical treatment were thinned from below, removing roughly one-third of the live tree biomass over the first decade of the simulation. Stands selected for mechanical thinning were only thinned once in the simulations, and all thinning was completed within the first decade*."[167]

Their results suggested that thinning the most optimum 33% of the operable acres could achieve the same effect as thinning all operable acres. The study was simulated in the Sierra Nevada of California, but the authors asserted that their approach was *"broadly applicable to historically frequent-fire ecosystems, or systems which have transitioned away from a low severity and fuel limited fire regime to one characterized by high-severity fires*."[168]

The authors have recently completed similar optimization simulations in the Santa Fe Fireshed, which is likely to provide additional direction for utilizing such an approach in Southwestern ponderosa pine and mixed conifer forests (findings are to be published soon).[169]

Why doesn't the scoping document make mention of this important, local research?

We believe that it is possible and beneficial to integrate the existing fire behavior and risk assessment modelling into an optimization simulation based on that work. We recommend that the Hurteau Lab is contacted immediately to begin dialogue as to how an optimization process can take existing fire modelling to the next level of strategic utility.

Three-tier Management Area Strategy

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[167] p. 2 in Krofcheck *et al*. 2017a

[168] p. 6 in Krofcheck *et al*. 2017a

[169] Personal communication: Matt Hurteau, University of New Mexico, March 29, 2018

Reflecting advances in landscape level planning, the *Strategic Treatments for Fire Use Alternative* proposes a three-tier strategy, basing management area decisions on optimized treatment locations rather than just arbitrary distances from values-at-risk. Past management zone strategies have been proposed by fire ecologists to facilitate resource benefit fire in Wilderness areas, and were based on distance from the wildland-urban interface.[170] Later, those approaches were extended to non-Wilderness public lands beyond a 5 ½ mile buffer around private land.[171] Both of those distance-dependent approaches resulted in identification of community protection zones, restoration management zones, and fire use zones. More recently, USFS and academic scientists called for a similar three-zone approach to be incorporated into National Forest Land and Resource Management Plans, with no specification of zone distances from the wildland-urban interface.[172] Conversely, the *Strategic Treatments for Fire Use Alternative* proposes that thinning treatments be prioritized in the Wildland Urban Interface, around critical infrastructure, and in areas having the highest probability of active crown fire, irrespective of proximity to human values-at-risk.

The three tiers of the Alternative are as follows:

Tier 1) Community Protection. These areas should be highest priorities for mechanical treatment, where feasible. Identification of the Community Protection Areas follows a ½ mile around homes and critical infrastructure. Additional areas that demand special attention may be addressed through a collaborative stakeholder process.

Tier 2) Strategic Thinning Treatment. These areas should be the next level of priority for mechanical treatment. *Strategic Thinning Treatment* areas would be identified through optimization analysis. An additional, secondary prioritization could be developed collaboratively to identify those stands which are the foremost priority for accelerated mechanical treatment within this zone. This analysis should include all "other projects" within the Project footprint, because "*Understanding where past fuel treatments and wildfires have occurred is important for prioritizing future fuel treatment.*"[173] Based on the 2010 synopsis competed by Collins and colleagues, a reasonable starting point may be that approximately 20% of the operable landscape could be targeted for strategically placed treatments, which would equate to approximately 28,000 acres of the project footprint. Krofcheck and colleagues optimization simulations from the Sierra Nevada resulted in approximately 8.5% of the landscape being identified for mechanical treatment. It will be important to let the process speak for itself, but if the optimization successfully locates thinning treatment priorities within those ranges, that amount of available acreage would provide decades of contracts to local industry. These acres may be in

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[170] Wilmer and Aplet 2005. Managing the Landscape for Fire: A Three-Zone, Landscape-Scale Fire Management Strategy. The Wilderness Society, Washington, DC.

[171] Aplet and Wilmer 2010. The potential for restoring fire-adapted ecosystems: exploring opportunities to expand the use of wildfire as a natural change agent. *Fire Management Today* 70(10): 35-39.

[172] North *et al.* 2015b

[173] p. 301 in Vaillant and Reinhardt 2017

addition to those within the *Community Protection* areas and would be determined through the optimization analysis.

Tier 3) Fire Use. Areas located outside Tier 1 and 2 are not prioritized for mechanical treatment. Instead, management prioritizes prescribed and resource benefit fire at frequencies appropriate to local fire regimes. Because progressively warmer and drier winters may be conducive to year-long prescribed fire,[174] we recommend that increased resources are made available for burning, including the use of Prescribed Fire Training Exchanges (TREX), Wildland Fire Modules, forming prescribed fire councils, and a dedicated prescribed fire implementation team.[175] The Project is lucky that the Forest Guild is so conveniently poised to provide this support.

Why Analyze the Strategic Treatments for Fire Use Alternative?

The *Strategic Treatments for Fire Use Alternative* seeks to achieve a realistic, attainable outcome where values-at-risk are protected from undesirable fire effects, while natural process-structure interactions drive ecosystem restoration and improve resiliency. We stand by our assertion that workforce limitations render impossible the goal of logging one-half of the project area. Therefore, it is reasonable and prudent to consider an intermediate approach, whereby a subset of strategically located thinning treatments can be implemented in order to facilitate fire-based restoration across the broader landscape.

Fundamental to nearly every published research on forest restoration practices is the need for strategically prioritizing and placing mechanical thinning treatments that facilitate safe application of prescribed and wildland fire. At the core of the *Strategic Treatments for Fire Use Alternative* is our position that the current direction in planning, analysis and implementation in the Project is overly reliant on meeting structural and compositional targets, representing what is in effect a non-viable silvicultural solution to a complex ecological problem. The quest to create the ideal vegetative state across every operable acre has marginalized the overriding importance of fire-driven ecological processes. Applying a new form of growth and density regulation, as articulated in GTR-310, cannot by itself accomplish restoration at meaningful landscape scale; only the additive effects of frequent fire can fully restore these ecosystems.

Strategically placed mechanical thinning has a critical role in the Project in order to reduce the risk of uncharacteristic fire and prepare the landscape for safe wildfire re-entry.[176] Considering that much of the Project landscape is currently densely stocked with dangerous surface fuel loads and ladder fuels, mechanical thinning is a viable tool for preparing those areas for successful re-establishment of a predominantly low-intensity, frequent fire regime. However, if current workforce trends continue, that work cannot be accomplished at a pace commensurate with the scale of the ecological problem, and as such a course correction is needed. Because many acres

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[174] Seager *et al.* 2007. Model projections of an imminent transition to a more arid climate in southwestern North America. *Science* 316:1181.

[175] Stephens *et al.* 2016

[176] Stephens *et al.* 2016. U.S. federal fire and forest policy: emphasizing resilience in dry forests. *Ecosphere* 7(11): 1-19.

identified for thinning may be poor candidates for economically-viable mechanical treatment but suitable for fire-based restoration, strategic placement of mechanical thinning is essential.

Leading fire scientists and managers have stated that nationwide "*The current priority and pace of fuels treatments outside the WUI is unlikely to significantly influence fire intensity and severity*."[177] Across the western United States, fuels reduction and forest restoration treatments are not keeping up with the historic fire return intervals for National Forest lands, including dry southwestern forests, resulting in a continued 'fire-deficit' where only about 50% of the required disturbance occurs on an annual basis.[178] The persistent disturbance deficit is a relic of failed past land management practices of commercial logging, fire suppression, grazing, and road building,[179] and continues to generate negative outcomes resulting from compensatory management responses, such as continued fire suppression.[180] Because of economic, legal, and logistical limitations which restrict effective large-scale restoration,[181] a full suite of techniques should be utilized to achieve restoration objectives, including dramatically increased use of prescribed fire and expanding the use of unplanned ignitions for resource benefit.[182]

The Strategic Treatments for Fire Use Alternative Follows National Agency Priorities

The dramatic deficit of annual acreage burned in frequent-fire adapted forests has led senior USFS scientists to call for increasing the scale and rate of fuels treatments following three key strategies:[183]

> 1) Increasing the extent of fuel treatments if resources permit;
>
> 2) Designing treatments to create conditions conducive to naturally ignited fires burning under desired conditions while fulfilling an ecological role; and

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177 p. 393 in North *et al.* 2012.

178 Vaillant and Reinhardt 2017. An evaluation of the Forest Service hazardous fuels treatment program—are we treating enough to promote resiliency or reduce hazard? *Journal of Forestry* 115(4): 300-308.

Personal communication: Tessa Nicolet, USFS Region 3 Fire Ecologist, Sept. 23, 2017.

179 Kauffman 2004. Death rides the forest: perceptions of fire, land use, and ecological restoration of western forests. *Conservation Biology* 18(4): 878-882.

180 Calkin *et al.* 2015. Negative consequences of positive feedbacks in US wildfire management. *Forest Ecosystems* 2:9.

181 Collins *et al.* 2010

182 Stephens *et al.* 2009. Fire treatment effects on vegetation structure, fuels, and potential fire severity in western U.S. forests. *Ecological Applications* 19(2): 305-320.

North *et al.* 2015b.

183 p. 301in Vaillant and Reinhardt 2017. An evaluation of the Forest Service hazardous fuels treatment program—are we treating enough to promote resiliency or reduce hazard? *Journal of Forestry* 115(4): 300-308.

3) Placing treatments to reduce hazard while providing options for firefighting when highly valued resources and assets are present.

These strategies are becoming widely accepted by fire scientists and managers, but intransigence remains firmly rooted in certain elements of USFS culture.[184] The *Strategic Treatments for Fire Use Alternative* is rooted in these strategies and demonstrative of the approach promoted in the *National Cohesive Wildland Fire Management Strategy* ("National Strategy").

The National Strategy identifies this general guidance for Vegetation and Fuels Management:[185]

i. **Design and prioritize fuel treatments.** Where wildfires are unwanted or threaten communities and homes, design and prioritize fuel treatments to reduce fire intensity, structure ignition, and wildfire extent.

ii. **Strategically place fuel treatments.** Where feasible, implement strategically placed fuel treatments to interrupt fire spread across landscapes.

iii. **Increase the use of wildland fire for meeting resource objectives.** Where allowed and feasible, manage wildfire for resource objectives and ecological purposes to restore and maintain fire-adapted ecosystems and achieve fire-resilient landscapes.

iv. **Continuing and expanding the use of all methods to improve forest and range resiliency.** Continue and expand the use of prescribed fire to meet landscape objectives, improve ecological conditions, and reduce the potential for high-intensity wildfires. Use and expand fuel treatments involving mechanical, biological, or chemical methods where economically feasible and sustainable, and where they align with landowner objectives.

The *Strategic Treatments for Fire Use Alternative* puts equal emphasis on these four courses of action.

The National Strategy clearly asserts that "*Prescribed fire and managing wildfire for resource objectives have the greatest potential for treating large areas at lower cost than mechanical treatments.*"[186] Researchers have long asserted that "*Prioritizing restoration efforts is essential because resources are limited. An initial focus on areas most likely to provide benefits and that*

[184] Doane *et al.* 2006. Barriers to wildland fire use a preliminary problem analysis. *International Journal of Wilderness* 12(1): 36-38.

North *et al.* 2015b. Reform forest fire management – agency incentives undermine policy effectiveness. *Science* 349(6254): 1280–1281.

Stephens *et al*. 2009. Fire treatment effects on vegetation structure, fuels, and potential fire severity in western U.S. forests. *Ecological Applications* 19(2): 305-320.

[185] pp. 1 and 58 in National Strategy 2014: https://www.forestsandrangelands.gov/strategy/thestrategy.shtml

[186] p. 58 in National Strategy 2014

present a low risk of degradation of ecological values will build experience and credibility."[187] Prominent fire scientists have recently affirmed that "*Strategically placing fuel treatments to create conditions where wildland fire can occur without negative consequences and leveraging low-risk opportunities to manage wildland fire will remain critical factors to successful implementation of the* [National] *Strategy.*"[188] The *Strategic Treatments for Fire Use Alternative* considers these fundamental principles, and prioritizes mechanical thinning where it would be most effective to ensure community protection, preserve recreational opportunities, and restore predominantly low-intensity fire regimes.

This approach is further called for in the 2012 Mexican Spotted Owl Recovery Plan, which suggests that restoration projects "*Conduct a landscape-level risk assessment to strategically locate and prioritize mechanical treatment units to mitigate the risk of large wildland fires while minimizing impact to PACs*."[189]

Prominent fire scientists and managers are increasingly calling for strategically placed treatments on portions of the landscape in order to safely facilitate the use of prescribed and managed wildfire to achieve restoration of frequent fire adapted ecosystem processes, composition, and structure. USFS researchers have established that any science-based planning should ask "*Which locations provide the greatest strategic opportunity for fuel treatments that would facilitate attainment of desired conditions*?"[190] The *Strategic Treatments for Fire Use Alternative* asks this important question.

One of the Nation's foremost forest restorationists has stated that "*restoration of surface fire in most sites and thinning in strategic sites will increase resistance to severe wildfire at the stand and landscape scales, insect pathogens, and invasive non-native species.*"[191] We agree with that assertion and believe that the Forest Service should address this by analyzing our alternative.

We therefore request the USFS to analyze the *Strategic Treatments for Fire Use Alternative* as a standalone alternative in any subsequent NEPA document.

What is involved in the Strategic Treatments for Fire Use Alternative?

By integrating fire behavior modelling methodologies already used by the Forest Service with treatment optimization simulations, the *Strategic Treatments for Fire Use Alternative* builds

[187] Brown *et al*. 2004. Forest restoration and fire: principles in the context of place. *Conservation Biology* 18(4): 903-912.

[188] p. 8 in Barnett *et al.* 2016. Beyond fuel treatment effectiveness: characterizing interactions between fire and treatments in the US. *Forests* 7(237): 1-12.

[189] p. 262 in USFWS 2012 Mexican Spotted Owl Recovery Plan, First Revision (*Strix occidentalis lucida*). Southwest Region U.S. Fish and Wildlife Service Albuquerque, New Mexico.

[190] Peterson and Johnson 2007. Science-based strategic planning for hazardous fuel treatments. *Fire Management Today* 67(3): 13-18.

[191] p. 529 in Fulé 2008

upon the work already underway by the USFS and eliminates any perceived need to "reinvent the wheel." The additional analytical overlays that define the *Strategic Treatments for Fire Use Alternative* would prioritize treatment areas following a treatment optimization technique developed by scientists at the Earth Systems Ecology Lab at the University of New Mexico (the Hurteau Lab). Their research[192] has developed "*prioritization strategies for implementing fuel treatments… with the goal to maximize treatment efficacy using optimal placement and prescription options under typical and extreme fire weather conditions*." [193] We propose a tiered implementation structure that combines existing treatment direction, optimized treatment locations, and fundamental restoration principles to define three zones with distinct management approaches. This approach could inform landscape-scale restoration planning nationwide, as "*Testing of strategic placement of treatments by resource managers will add data in the years ahead and provide information that can be shared and applied in other locations*."[194]

This framework offers a pathway to return to the New Mexico Forest Restoration Principles original intent of prioritizing and strategically placing treatments, consistent with the most frequently cited principles for ecological restoration of southwestern ponderosa pine forests, which explicitly urge practitioners to "*Prioritize and strategically target treatment areas.*"[195] The USFS's current emphasis on aggressive structural manipulation to very low densities, as articulated in GTR-310 is an essentially unproven approach that is well outside the current zone of agreement among the stakeholders signed on to this letter. Landscape scale thinning treatments should instead "*focus on creating conditions in which fire can occur without devastating consequences.*"[196]

Mechanical restoration treatments, while proven effective to emulate historical structural and compositional attributes,[197] are not the only valid approach to enhancing resiliency, diversity, and function in fire-adapted forests. A range of treatments that can be realistically implemented is required. In a sweeping review of federal fire policy, Stephens and others recommended that

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[192] Krofcheck *et al*. 2017a. Prioritizing forest fuels treatments based on the probability of high-severity fire restores adaptive capacity in Sierran forests. *Global Change Biology DOI: 10.1111/gcb.13913.*

Krofcheck *et al*. 2017b. Restoring surface fire stabilizes forest carbon under extreme fire weather in the Sierra Nevada. *Ecosphere* 8(1): 1-18.

[193] http://www.hurteaulab.org/

[194] p. 15 in Peterson and Johnson 2007

[195] p. 1424 in Allen *et al.* 2002. Ecological restoration of southwestern ponderosa pine ecosystems: A broad perspective. *Ecological Applications* 12(5): 1418-1433.

[196] p. 1988 in Reinhardt *et al.* 2008. Objectives and considerations for wildland fuel treatment in forested ecosystems of the interior western United States. *Forest Ecology and Management* 256: 1997-2006.

North *et al*. 2012. Using fire to increase the scale, benefits, and future maintenance of fuels treatments. *Journal of Forestry* 110(7): 392-401.

[197] Fulé *et al.* 2012. Do thinning and/or burning treatments in western USA ponderosa or Jeffrey pine dominated forests help restore natural fire behavior? *Forest Ecology and Management* 269: 68-81.

the number one improvement that could be made in planning and implementing forest and fire management is to "*mandate evaluation of opportunities for ecologically beneficial fire in land management planning*."[198]

A 2013 Ecological Restoration Institute synopsis titled *Fuel Treatment Longevity*[199] identified 25 factors affecting fuel treatment longevity. Among those was "Treatment Intensity," which was only briefly mentioned as a bulleted point, and no evidence was provided supporting the notion that high intensity thinning to very low basal areas increased resilience or prolonged treatment effectiveness. In fact the opposite effect was depicted, as that synopsis cited a study from northern Arizona where "*higher-intensity treatments were found to have twice the number of ponderosa pine seedlings as low-intensity restoration treatments*,"[200] an example of where aggressive thinning may encourage dramatic increases in ladder fuels.

Is the Santa Fe National Forest able to manage thousands of acres of regeneration filling all of the interspaces created under a GTR-310 management paradigm?

The Strategic Treatments for Fire Use Alternative Minimizes Significant Controversy Related to GTR-310 and Aggressive Logging Treatments in Protected Habitats

We reject a framework which assumes that complex ecosystems can be wrangled into fixed proportions of tree ages and sizes that must be repeatedly tinkered with at 20 or 30-year rotations to maintain "desired conditions." In areas where strategically located mechanical intervention is implemented, fire alone can and should be the primary future maintenance tool.[201] Measuring the health of the forest on the basis of density-metrics represents a worn-out allegiance to a past industrial paradigm. This regulated-forest model defines successful restoration as growing large, defect-free trees as quickly as possible and ignores the complexity of process-centered ecosystem function. Restoring a forest is not an exercise in manipulating every quantifiable metric into a neat category, or alleviating any form of stress that might lead to unexpected mortality.

Renowned fire ecologist Dr. Pete Fulé stated that "*The fire-related adaptations of pine forests are associated with fire's role as a selective force going far back in evolutionary time,*"[202] suggesting that restoration of fire adapted dry forests is inseparable from the influence of recurrent fire as a primary selective force.

The effect of mechanical thinning to very low density and basal area on drought resistance in ponderosa pine and mixed conifer forests has not been studied in long-term, replicated studies

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[198] p. 4 in Stephens *et al.* 2016

[199] Yocum 2013. Fuel Treatment Longevity. Ecological Restoration Institute Working Paper No. 27.

[200] p. 5 in Yocum 2013

[201] North *et al.* 2012, Reinhardt *et al.* 2008

[202] p. 528 in Fulé 2008. Does it make sense to restore wildland fire in changing climate? *Restoration Ecology* 16(4): 526-531.

with broad geographic inference, and as such, is poorly understood.[203] Ecologists with USGS and USFS recently stated that "*the utility of basal area reduction for minimizing drought impacts in natural forests remains relatively unexplored, especially in dry forests like those of the Southwest US that may be particularly vulnerable to drought*."[204] There has been very little research to date assessing the effect of dramatic canopy reduction on soil heating and drying, which are significant concerns to forest managers.

Complicating the translation of best available scientific information into management direction is the lack of consistency among key descriptors of forest density, especially as it relates to the effects of mechanical thinning on tree ecophysiology and soil-water/drought relationships. Such was the case with Petrie and colleagues research which suggests that 'intermediate' level thinning that minimizes soil surface temperatures will likely promote survival of ponderosa pine seedlings under climate change driven temperature rise.[205] While they do not provide any clarity on what 'intermediate' thinning constitutes, it is noteworthy that they did not suggest 'low' density thinning as a panacea for drought resistance. Another example can be found with Zou and colleagues, who studied soil water dynamics in 'low-density' and 'high-density' ponderosa pine stands at 7,550 ft. on the Pajarito Plateau of New Mexico[206]. They found that over a 4-year period, the 'low-density' stand had an order of magnitude more water available on a per-tree basis than did the 'high-density' stand. It is important to note the condition of the two stands: the 'high-density' stand had 2710 trees/hectare (1120 trees/acre) while the low-density stand had 250 trees/hectare (103 trees/acre). These results suggest that thinning down to moderate densities at the upper end of the USFS's self-crafted "Desired Conditions" and GTR-310 is effective at increasing soil water significantly, and provide another example of how the scale of densities reported in research is not necessarily consistent with ranges debated within management dialogue or proposed for the Project.

Bradford and Bell studied the interactions between tree basal area and climate across 1,854 Forest Inventory and Analysis plots in Arizona, New Mexico, Utah, Colorado, and Wyoming.[207] They found strong evidence that tree mortality is positively related to 'high' stand basal area for ponderosa pine and Douglas-fir, and that managing to 'lower' basal areas may decrease future climate-induced mortality due to high temperatures and low moisture predictions. However, their study did not define 'high,' 'medium,' and 'low' basal areas, which essentially precludes managers from translating the results into actionable guidelines. Supplemental charts provided

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[203] D'Amato *et al.* 2013. Effects of thinning on drought vulnerability and climate response in north temperate forest ecosystems. *Ecological Applications* 23(8): 1735-1742

[204] p. 12 in Bradford and Bell. 2017. A window of opportunity for climate-change adaptation: easing tree mortality by reducing forest basal area. *Frontiers in Ecology and the Environment* 15(1): 11-17

[205] Petrie *et al.* 2017. Climate change may restrict dryland forest regeneration in the 21st century. *Ecology* 98(6): 1548-1559.

[206] Zou *et al.* 2008. Soil water dynamics under low-versus high-ponderosa pine tree density: ecohydrological functioning and restoration implications. *Ecohydrology* 1: 309-315.

[207] Bradford and Bell 2017

on-line by the researchers did not provide clarity, as there are no labels noting whether density was reported in metric or standard units.

As another example, Kerhoulas and colleagues found that 'heavy thinning' of ponderosa pine stimulated growth, improved drought resistance, and provided greater climate change resilience.[208] Again, the definition of 'heavy' is not standardized, and in this case 'heavy thinning' equated to thinning down to approximately 70 ft^2/acre of basal area, while 'moderate thinning' was down to ~80 ft^2 /acre and 'light thinning' was down to ~98 ft^2. Overall, the effects of thinning to the low end of basal area range on soil surface temperatures, soil drying during pre-monsoon drought, and related variables has not been adequately studied. Until scientists can provide clear answers, caution is warranted.

The cumulative effects of re-establishing frequent fires should not be understated. Even with cool, low-severity burns, post-treatment mortality may range between 10% and 30% of the residual trees.[209] As an example, the photo below shows a portion of the GTR-310 Bluewater demonstration site on the Cibola National Forest, New Mexico. The 73-acre site was thinned to <32 ft^2/acre and ~25 trees/acre[210] in 2010. Despite the very low density of the remaining forest, a patch of more than 50 trees across 2 acres were killed by the first fire entry following thinning. This unexpected incident of torching led to the death of at least three old-growth trees and calls into question the efficacy of attempts to restore desired structure without consideration of the aggregate effects of re-establishing frequent fire.

A 2 acre patch of mortality at the GTR-310 Bluewater Demonstration site following initial prescribed fire re-entry, July 2017

[208] Kerhoulas *et al.* 2013. Managing climate change adaptation in forests: a case study from the U.S. Southwest. *Journal of Applied Ecology* 50: 1311–1320.

[209] Fulé *et al*. 2005. Pine-oak forest dynamics five years after ecological restoration treatments. *Forest Ecology and Management* 218: 129–145; Fulé *et al*. 2007. Posttreatment tree mortality after forest ecological restoration, Arizona, United States. *Environmental Management* 40: 623-634

[210] July 2017 Center for Biological Diversity field inventory of 13 paired 1/10th-acre and 1-acre inventory plots.

In response to the shortcomings inherent in restoration projects which rely on extensive mechanical thinning, government and academic scientists have called for reconsideration of the strict adherence to historic structural attributes as the clearest pathway towards building resilience into dry fire-adapted forests. Williams and colleagues suggested that in the dynamic context of climate change threatening the sustainability of transitional environments, restoration "*must move beyond frameworks where historic structure and composition are fixed targets for recovery.*"[211] Similarly, Millar and colleagues stated that "*attempts to maintain or restore past conditions require increasingly greater inputs of energy from managers and could create forests that are ill adapted to current conditions and more susceptible to undesirable changes… Decisions that emphasize ecological process, rather than structure and composition, become critical.*"[212] The *Strategic Treatments for Fire Use Alternative* is consistent with that framework, and more in line with widely accepted principles for ponderosa pine forest restoration[213] than the approach currently codified in the proposed action.

Restoring a Landscape Requires Expanding the Use of Fire

Abundant evidence points to the success of fuels reduction treatments including thinning, burning, and combinations of the two at restoring natural fire behavior,[214] even though restoration treatments may not produce significant changes in mean diameter, canopy base height, surface fuels, spatial aggregation, or vertical heterogeneity.[215] Despite the benefits accrued from thinning treatments, restoration of fire-adapted natural and human communities in the Project landscape will require a substantial increase in the area burned annually.

Among USFS Regions, Vaillant and Reinhardt found that the Southwest (Region 3) is far ahead of the rest of the country in returning fire to the landscape[216]. Their analysis showed that Region 3, compared to the 6 other western Regions, has proportionally the most acres burned by characteristic severity wildfire, the smallest deficit of land area needing treatment to match historical acreage-burned, and the least amount of area being mechanically treated

Strategically placed treatments that facilitate the management of wildfire for resource benefit can lead to the required increases in annual wildfire acres burned.[217] Resource benefit fires tend to

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[211] p. 21293 in Williams *et al.* 2010. Forest responses to increasing aridity and warmth in the southwestern United States. *Proceedings of the National Academy of Sciences* 107(50): 21289-21294.

[212] pp. 2145-2146 in Millar *et al.* 2007. Climate change and forests of the future: managing in the face of uncertainty. *Ecological Applications* 17(8): 2145-2151.

[213] See Allen *et al.* 2002

[214] Fulé *et al.* 2012

[215] Ziegler *et al.* 2017. Spatially explicit measurements of forest structure and fire behavior following restoration treatments in dry forests. *Forest Ecology and Management* 386: 1-12.

[216] Vaillant and Reinhardt 2017

[217] Vaillant and Reinhardt 2017

cover far more acres than do thinning and prescribed fire treatments.[218] Large treatments can be more effective at moderating fire behavior relative to smaller treatments because they contain more interior area and less edge and are more likely to be encountered by a wildfire.[219] Large fire footprints are more effective at modifying future fire activity than small fires and generally reduce the size of subsequent overlapping burns that occur within ten years of the initial fire, which increases manageability and benefits of subsequent fires.[220]

Breaking the typical cycle of management reaction and suppression response by increasing the scale and frequency of large prescribed and resource benefit fire use will support sustainable feedback mechanisms whereby future suppression efforts, even in severe fire-weather events, become less necessary.[221] Because the Southwest has entered an era of longer, hotter, drier, and unpredictable fire seasons, it is critical that fire use is accelerated in order to reduce fuels, restore ecosystem process, create landscape heterogeneity, and reduce the impact and severity of the next big blaze beyond the horizon.

Evidence of Mixed Fire Severities in Southwestern Frequent-Fire Forests

Multiple lines of evidence support the occurrence of fire effects outside the traditionally accepted notion that low-severity fire was characteristic of southwestern middle elevation forest types. This is particularly relevant to the Project as the project area includes a range of elevations spanning most fire regimes imaginable for the southwestern United States. Generalizing desired conditions to suggest that all fires should be low-intensity surface fires ignores the bulk of scientific evidence to support that pinyon-juniper, mixed conifer, and spruce fire ecosystems commonly burned at high severity, and occasionally ponderosa pine did as well.

This section discusses this growing body of evidence and is specifically focused on southwestern ponderosa pine and ponderosa pine dominated dry mixed-conifer ecosystems. These studies should form the basis of your decision making. Because the occurrence of mixed-severity fire is now recognized as within the historical range of variability for these forests, and there are noteworthy advantages of such effects, there is valid scientific support for utilizing it as a restoration tool *where appropriate and feasible in a manner that does not put communities, infrastructure, and other key values at risk*.

Traditionally, the extensive body of literature surrounding restoration of ponderosa pine and dry mixed-conifer ecosystems has supported the notion that fires burned almost exclusively at low-

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[218] Hunter *et al.* 2011. Short- and long-term effects on fuels, forest structure, and wildfire potential from prescribed fire and resource benefit fire in southwestern forests, USA. *Fire Ecology* 7(3): 108-121.

[219] Barnett *et al.* 2016

[220] Teske *et al.* 2012. Characterizing fire-on-fire interactions in three large wilderness areas. *Fire Ecology* 8(2): 82-106.

[221] Calkin *et al*. 2015. Negative consequences of positive feedbacks in US wildfire management. *Forest Ecosystems* 2:9.

North *et al.* 2015b

severities. In a seminal paper on the subject, Moore and colleagues stated that "*low-frequency, high intensity stand replacement fires were very rare or nonexistent.*"[222] However, a growing body of research during intervening years, described here, suggests that a mix of severities have historically occurred across landscapes similar to or including the Project landscape. For example, Owen and colleagues stated frankly that "*ponderosa pines evolved under fire regimes dominated by low- to moderate-severity wildfire*"[223] which is a substantial philosophical departure from Moore and colleagues' statement. Additionally, Fulé and colleagues, in their noteworthy response to Williams and Bakers[224] claims of widespread high-severity fires in northern Arizona's forests, stated that "*historical fires in relatively dry forests dominated by ponderosa pine included a range of fire severities*."[225]

The historical phenomenon of stand-replacing fire and attendant debris flows in ponderosa pine dominated mixed-conifer forests have been recorded at Kendrick Mountain on the Kaibab National Forest, Missionary Ridge in the San Juan Mountains of Colorado, The Jemez Mountains of New Mexico, at Rio Puerco in northern New Mexico, the Sacramento Mountains of New Mexico, and elsewhere throughout the West.[226] While the methods used to age severe fire events cannot suggest the size of such events, these studies uniformly conclude that fire

[222] p. 1269 in Moore *et al.* 1999. Reference conditions and ecological restoration: a southwestern ponderosa pine perspective. *Ecological Applications* 9(4): 1266-1277.

[223] p. 134 in Owen *et al.* 2017. Spatial patterns of ponderosa pine regeneration in high-severity burn patches. *Forest Ecology and Management* 405: 134-149.

[224] Williams, M.A. and W.L. Baker. 2012. Spatially extensive reconstructions show variable severity fire and heterogeneous structure in historical western United States dry forests. *Global Ecology and Biogeography* 21(10): 1042-1052.

[225] p. 827-828 in Fulé, P.Z., T.W. Swetnam, P.M. Brown, D.A. Falk, D.L. Peterson, C.D. Allen, G.H. Aplet, M.A. Battaglia, D. Binkley, C. Farris, R.E. Keane, E.Q. Margolis, H. Grissino-Mayer, C. Miller, C.H. Seig, C. Skinner, S.L. Stephens, and A. Taylor. 2014. Unsupported inferences of high-severity fire in historical dry forests of the western United States: response to Williams and Baker. *Global Ecology and Biogeography* 23: 825-830.

[226] Jenkins *et al.* 2011. Late Holocene geomorphic record of fire in ponderosa pine and mixed-conifer forests, Kendrick Mountain, northern Arizona, USA. *International Journal of Wildland Fire* 20: 125-14

Bigio *et al.* 2010. A comparison and integration of tree-ring and alluvial records of fire history at the Missionary Ridge Fire, Durango, Colorado, USA. *The Holocene* 20(7): 1047-1061.

Fitch 2013. Holocene fire-related alluvial chronology and geomorphic implications in the Jemez Mountains, New Mexico. M.S Thesis, University of New Mexico, Albuquerque, NM.

Meyer and Frechette 2010. The Holocene record of fire and erosion in the southern Sacramento Mountains and its relation to climate. *New Mexico Geology* 32(1): 19-21.

French *et al.* 2009. Holocene alluvial sequences, cumulic soils and fire signatures in the middle Rio Puerco basin at Guadalupe Ruin, New Mexico. *Geoarchaeology* 24(5): 638-676.

Pierce and Meyer 2008. Late Holocene records of fire in alluvial fan sediments: fire-climate relationships and implications for management of Rocky Mountain forests. *International Journal of Wildland Fire* 17*:* 84-95.

behavior is highly sensitive to relatively modest climatic change and that it is important to include mixed-severity fire at centennial to millennial scales as a component of the natural range of variability. Roos and Swetnam reported that the combined effects of a century long fire-free period (1360 to 1455) punctuated by two unusually wet periods and followed by a hemispheric mega-drought may have led to conditions that supported widespread crown fires in southwestern ponderosa pine forests. They also suggested that similar periods of reduced fire frequency in the eighth, ninth, and sixteenth centuries may have "*led to altered forest structures that were more vulnerable to increased fire severity.*"[227] The likelihood of the past occurrence of similar large scale stand replacing fires in the Sangre de Cristo Mountains should not be discounted.

Fire history research has provided additional support for mixed fire severities in more recent centuries. Hunter and colleagues reported that high-severity burn patches within moderate severity burn matrixes in ponderosa pine and pinyon-juniper ecosystems on the Gila National Forest were generally smaller than, but up to, 120 hectares.[228] Those findings corroborate Abolt's determinations that historical stand-replacing patches in the Mogollon Mountains ranged from 6 to 103 hectares along an elevational gradient, based off of aged aspen stands.[229] In a fire history study in the Black Mesa Ranger District of the Apache-Sitgreaves National Forest, Huffman and colleagues determined that their 1,300 hectare study site (7,600-7,900 ft.) was dominated by frequent, low-severity fires that maintained a ponderosa pine-dominated mixed conifer plant community. However, they did suggest that fire-induced even-aged regeneration events up to 25 hectares in size did occur historically, based off of spatial patterns of large trees and stumps.[230] Williams and Baker concluded that around 30% of trees survived high-severity fires along the Mogollon Rim,[231] which was not refuted by Fule and Colleagues, although it led to a robust discussion of what the definition of 'high-severity' really is.[232]

Studies at Grand Canyon, the Mogollon Rim, and the Gila Wilderness are also consistent with research coming from the Sierra Nevada of California. For example, a study at Illilouette Creek Basin in Yosemite National Park (4,600-9,900 ft.) determined that in Jeffrey pine and mixed conifer forests that have seen a return to near-normal fire regimes, high-severity patch sizes

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[227] p. 288 in Roos and Swetnam 2011. A 1416-year reconstruction of annual, multidecadal, and centennial variability in area burned for ponderosa pine forests of the southern Colorado Plateau region, Southwest USA. *The Holocene* 22(3): 281-291.

[228] Hunter *et al.* 2011.

[229] Abolt 1997. Fire histories of upper elevation forests in the Gila Wilderness, New Mexico via fire scar and age structure analysis. MS Thesis, University of Arizona, Tucson, AZ.

[230] Huffman *et al.* 2015. Fire history of a mixed conifer forest on the Mogollon Rim, northern Arizona, USA. *International Journal of Wildland Fire http://dx.doi.org/10.1071/WF14005*

[231] Williams and Baker 2012.

[232] Fulé *et al.* 2014.

made up 15% of burned areas, and were typically less than 4 hectares, with occasional patches up to 60 hectares.[233]

Yocum-Kent and colleagues utilized three sampling and analysis approaches to estimate historical high-severity fire patches in a high-elevation (~8,000-9,000 ft.) mixed conifer forest at Grand Canyon National Park. By aging aspen stands, aging even-aged patches of fire-sensitive trees, and by interpolating patch-size based off the oldest fire-sensitive tree in each plot area, and comparing to existing fire chronologies, the authors were able to estimate minimum, maximum, and mean patch size for high-severity mortality events. They concluded that in those high-elevation forests high-severity patches of fire were historically common and that "*Patch size of high-severity fire during the 1800s likely ranged from small patches that allowed a few trees to establish to large patches that initiated multiple stands across the landscape, on the order of* [10 to 100 hectares]."[234]

Recent fire activity at Grand Canyon is apparently not overly departed from this historical pattern. Based off National Park Service records, during a twelve year period (2000-2012) at the North Rim, twenty-five mixed-severity fires burned 2,294 individual high-severity fire patches across 6,221 hectares. The majority of patches were small (95% were <5 hectares) but three patches were between 500 and 1,300 hectares, accounting for 44% of total high-severity fire area. Furthermore, because of the overall young age of the 1,400 hectare study are and the relative infrequency of very old trees, they couldn't "*rule out a large stand-replacing fire in* [our] *study region in 1685, or even later, in the mid-1700s,*" causing them to speculate that perhaps modern patch sizes at the North Rim were not necessarily unprecedented at the centuries-scale.[235] Margolis and colleagues reported that stand-replacing patch sizes in mixed-conifer forests above 8,500 ft. on the Mogollon Plateau were historically up to nearly 300 hectares in size, with some individual fires contributing multiple patches of 100 hectares or more.[236]

The restoration of functional natural fire processes in the future is likely to regulate ecosystem structure and composition[237] and re-establish a new dynamic equilibrium that tracks climate effects on vegetation and landscape pattern in real time.[238] Cutting-edge research has concluded

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[233] Collins and Stephens 2010. Stand-replacing patches within a 'mixed-severity' fire regime: quantitative characterization using recent fires in a long-established natural fire area. *Landscape Ecology* 25: 927-939.

[234] Yocum-Kent, L.L., P.Z. Fule, W.A. Bunn, and E.G. Gdula. 2015. Historical high-severity fire patches in mixed-conifer forests. *Canadian Journal of Forest Research* 45: 1587-1596.

[235] *Ibid* at page 1594

[236] Margolis, E. Q., and J. Balmat. 2009. Fire history and fire-climate relationships along a fire regime gradient in the Santa Fe Municipal Watershed, NM, USA. *Forest Ecology and Management* 258: 2416-2430.

[237] Parks, S.A., L.M. Holsinger, C. Miller, and C.R. Nelson. 2015. Wildland fire as a self-regulating mechanism: the role of previous burns and weather in limiting fire progression. *Ecological Applications* 25(6): 1478-1492.

[238] Falk 2006. Process-centered restoration in a fire-adapted ponderosa pine forest. *Journal for Nature Conservation* 14: 140-151.

that these small patches of near or total mortality contribute to spatial heterogeneity, and may be consistent with historical spatial patterns.[239] After observing the effects of numerous resource benefit fires in the Gila Wilderness, Holden and colleagues concluded that fire-caused openings ranged in size from 0.25 to 20 hectares and that "*most of the risks, in terms of mortality to medium- and large-diameter trees are associated with the first fire after long periods of fire exclusion.*"[240]

Increased frequency, extent, and severity of wildland fires may attend climate warming and increasing drought.[241] Numerous research approaches using a range of modelling techniques suggest that widespread conifer mortality, diminished recruitment opportunities, and high-severity fire feedbacks will reduce the range and sustainability of southwestern forested ecosystems.[242] Ponderosa pine forests have survived past mega-droughts and protracted mortality events, however,[243] suggesting that resilience-to and recovery-from extreme perturbations may be driven by complex multidirectional relationships between disturbance and abiotic and biotic factors.[244] Extreme droughts driving widespread mortality events can be followed by profoundly

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[239] Iniguez *et al.* 2009. Spatially and temporally variable fire regime on Rincon Peak, Arizona, USA. *Fire Ecology* 5: 3-21.

Margolis and Balmat 2009. Fire history and fire-climate relationships along a fire regime gradient in the Santa Fe Municipal Watershed, NM, USA. *Forest Ecology and Management* 258: 2416-2430.

Sensibaugh and Huffman 2014. Managing naturally ignited wildland fire to meet fuel reduction and restoration goals in frequent-fire forests. Ecological Restoration Institute Fact Sheet.

[240] p. 28 in Holden, Z.A., P. Morgan, M.G. Rollins, and K. Kavanaugh. 2007. Effects of multiple wildland fires on ponderosa pine structure in two southwestern wilderness areas, USA. *Fire Ecology* 3(2):18-33.

[241] Seager and Vecchi 2010. Greenhouse warming and the 21st century hydroclimate of southwestern North America. *Proceedings of the National Academy of Sciences* 107(50): 21277-21282.

Williams *et al.* 2010

[242] Savage *et al.* 2013. Double whammy: high-severity fire and drought in ponderosa pine forests of the southwest. *Canadian Journal of Forest Research* 43: 570-583.

McDowell *et al.* 2015. Multi-scale predictions of massive conifer mortality due to chronic temperature rise. *Nature Climate Change*

Petrie, M.D., J.B. Bradford, R.M. Hubbard, W.K. Lauenroth, C.M. Andrews, and D.R. Schlaepfer. 2017. Climate change may restrict dryland forest regeneration in the 21st century. *Ecology* 98(6): 1548-1559.

Williams, A.P., C.D. Allen, C.I. Millar, T.W. Swetnam, J. Michaelsen, C.J. Still, and S.W. Leavitt. 2010. Forest responses to increasing aridity and warmth in the southwestern United States. *Proceedings of the National Academy of Sciences* 107(50): 21289-21294.

[243] Brown and Wu 2005. Climate and disturbance forcing of episodic tree recruitment in a southwestern ponderosa pine landscape. *Ecology* 86(11): 3030-3038.

[244] Puhlick *et al.* 2012. Factors influencing ponderosa pine regeneration in the southwestern USA. *Forest Ecology and Management* 264: 10-19.

wet periods where fire frequency declines and tree recruitment increases.[245] Extensive bark beetle outbreaks, such as those which repeatedly occurred on the Kaibab Plateau up to the period of fire-suppression initiation,[246] can create large openings within the forest canopy, which may have increased fire severity at the patch scale as downed logs were consumed.

This evolution of our understanding of drought, insects and diseases, and occasional mixed-severity fire occurring at limited scales within the natural range of variability, as well as the utility of such fires in restoring forest structure, provides needed justification for concerns that arise from expanding the use of fire to achieve beneficial outcomes. Based on these studies, prescribed and resource benefit fires could mimic historical fire behavior by accepting higher levels of mortality in patches of up to 100 hectares in ponderosa pine, and perhaps up to several hundred or more in mixed-conifer forests during the initial fire entry, *and only in areas where such fires can be managed to protect communities, infrastructure, and other key values*.

Benefits of Mixed-Severity Fires in Southwestern Frequent-Fire Forests

Implementing a strategic approach to facilitate the expanded use of prescribed and resource benefit wildfire includes a greater acceptance of mixed-severity fire across all vegetation types in the Project landscape. In this section, we review the state of our understanding of how mixed-severity fire can be a useful tool to achieve beneficial ecological outcomes. As described in the next section, sufficient evidence exists to support the occurrence of a range of fire effects in the evolutionary environment at multiple temporal scales. The diversity of fire effects is driven by factors that are common on the Project landscape, such as topographic variation, disturbance history, vegetation characteristics, and proximity to values-at-risk. Because wildland fire use has been increasingly used throughout the west, research on its ecological and practical benefits has multiplied. An extensive body of science now points towards a wide range of fire intensities and severities as a critical driver of ecological restoration and fuels reduction success.

Reducing fuels and restoring historic structure.

Agee and Skinner suggested that prescribed fire is generally effective at reducing surface fuels and raising canopy base height, but because of undesirable "severity thresholds" reductions in crown density were less easy to achieve.[247] Implementing the *Strategic Treatments for Fire Use Alternative* requires reconsideration of acceptable severity thresholds. A growing body of research from dry, frequent-fire adapted forests supports the use of moderate-severity prescribed

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[245] Brown, P.M., and R. Wu. 2005. Climate and disturbance forcing of episodic tree recruitment in a southwestern ponderosa pine landscape. *Ecology* 86(11): 3030-3038.

[246] Lang and Stewart 1910. Reconnaissance of the Kaibab National Forest. Available on-line at www.nau.edu/library/speccoll/manuscript/kaibab_recon.

Craighead 1924. The black hills beetle practicing forestry on the Kaibab. *Forest Worker*, November, 1924: 74.

Craighead 1925. The *Dendroctonus* problem. *Journal of Forestry* 23: 340-354.

[247] Agee and Skinner 2005. Basic principles of forest fuel reduction treatments. *Forest Ecology and Management* 211(1): 83-96.

and/or natural-ignition fire in a mosaic of severities to achieve fuels reduction objectives, as well as restoring historic structure and pattern. Patchy-mosaics resulting from mixed-severity fire provide timely opportunities to conduct additional prescribed burns while fuel continuity and density have been reduced.[248] Often, subsequent fires burn at lower severity and result in fewer changes to the forest.[249]

Low severity prescribed fire alone may not always reduce canopy density sufficient to meet fuels reduction or ecological restoration objectives.[250] On the Gila National Forest (outside of the Gila Wilderness) moderate-severity resource benefit fire more effectively reduced basal area, tree density, seedling density, crown bulk density, canopy base height, and surface fuel loads than did low-severity prescribed or resource benefit fires in ponderosa pine and pinyon-juniper ecosystems.[251] Because of reductions in crown bulk density and crown base height, moderate-severity resource benefit fires in ponderosa pine and pinyon-juniper ecosystem can be more effective at reducing predicted crown fire potential than low-severity prescribed fires, even under very severe fire weather conditions.[252]

Studying the effects of a mixed-severity fire in ponderosa pine and dry mixed-conifer forest on Kendrick Peak, Kaibab National Forest, Stevens-Rumann and colleagues observed that areas of moderate-severity burn effects with mortality rates generally ranging between 40%-80% had met target basal area thresholds the highest amount of ponderosa pine regeneration, optimum coarse woody debris loadings, adequate fine woody debris to carry a surface fire, and met minimum requirements for snags. The authors concluded that areas where 40-80% tree mortality occurred should be managed with reintroduction of frequent low-severity surface fires to maintain stand structure, and pointed out that these moderate-severity burned areas would be more resilient to future disturbance and would be easier to maintain than thinning overly dense ponderosa pine forests. [253] Similarly, Huffman and colleagues found that across ten single-entry resource benefit fires in northern Arizona, most structural and fuels targets were only met when fire-induced mortality exceeded 31%.[254] Hunter and colleagues compared prescribed and resource benefit fires on the Gila National Forest and their "*results show that a single fire of moderate severity alone can result in stand densities that more closely resemble pre-settlement conditions.*"[255]

[248] Williams *et al.* 2010

[249] Holden *et al.* 2007

[250] Stephens *et al.* 2009

[251] Hunter *et al.* 2011

[252] Hunter *et al.* 2011

[253] Stevens-Rumann *et al.* 2012. Ten years after wildfires: How does varying tree mortality impact fire hazard and forest resiliency? *Forest Ecology and Management* 267: 199-208.

[254] Huffman *et al.* 2017a. Efficacy of resource objective wildfires for restoration of ponderosa pine (*Pinus ponderosa*) forests in northern Arizona. *Forest Ecology and Management* 389: 395-403.

[255] p. 117 in Hunter *et al.* 2011

Pulses of dead trees resulting from patches of high-severity fire have led to speculation increased fuel loadings may lead to amplified reburn severity. In the Southwest, patches of fire-killed trees can be expected to have fallen and substantially decomposed within one decade,[256] and even in areas of very high mortality coarse woody debris is unlikely to exceed management recommendations for fuel loadings.[257] Studies from the dry forests of the Pacific Northwest have shown that standing dead and dead/down woody debris actually experienced lower severity subsequent fires than salvage logged and replanted sites.[258] Similarly, Meigs and colleagues discovered after analyzing several hundred fires in the Pacific Northwest that burn severity was generally lower in forests with higher cumulative bark beetle damage, and that burn severity continued to decrease with time.[259]

A number of studies have reported inadequate post-fire ponderosa pine regeneration and type-conversion to shrub or grassland habitats with decades-long legacy effects.[260] However, this is not a universal phenomenon. Despite the size of high-severity burn patches in the Rodeo-Chediski fire, ponderosa pine appears to be regenerating in abundance, spatial pattern, and uneven-agedness along a trajectory that is similar to historical structural characteristics, albeit with a higher abundance of sprouting oak and juniper species. [261] Also on the Rodeo-Chediski Fire, Shive and colleagues reported significantly more ponderosa pine regeneration in high severity burn patches than in low-severity patches.[262]

In spite of the tremendous size of the Rodeo-Chediski Fire – which we agree is dramatically beyond the scale of characteristic fire behavior in the southwestern ponderosa pine forest – the

[256] Roccaforte *et al.* 2012. Woody debris and tree regeneration dynamics following severe wildfires in Arizona ponderosa pine forests. *Canadian Journal of Forest Research* 42: 593-604.

Passovoy and Fulé 2006. Snag and woody debris dynamics following severe wildfires in northern Arizona ponderosa pine forests. *Forest Ecology and Management* 223: 237–246.

Savage and Mast 2005. How resilient are southwestern ponderosa pine forests after crown fire? *Canadian Journal of Forest Research* 35: 967-977.

[257] Stevens-Rumann *et al.* 2013. Pre-wildfire fuel reduction treatments result in more resilient forest structure a decade after wildfire. *International Journal of Wildland Fire* 22: 1108-1117.

[258] Thompson *et al.* 2007. Reburn severity in managed and unmanaged vegetation in a large wildfire. *Proceedings of the National Academy of Sciences* 104(25): 10743-10748.

[259] Meigs *et al.* 2016. Do insect outbreaks reduce the severity of subsequent forest fires? *Environmental Research Letters* 11.

[260] Haire and McGarigal 2008. Inhabitants of landscape scars: succession of woody plants after large, severe forest fires in Arizona and New Mexico. *The Southwestern Naturalist* 53(2): 146-161

Savage and Mast 2005

[261] Owen *et al.* 2017

[262] Shive *et al.* 2013. Pre-wildfire management treatments interact with fire severity to have lasting effects on post-wildfire vegetation response. *Forest Ecology and Management* 297: 75-83.

situation today is not as grim as it appeared in the fires immediate aftermath. Leveraging the reduced fuels across the Rodeo-Chediski fire area to return low-intensity prescribed fire would be useful for limiting the degree to which sprouting woody species dominate the post-fire community, breaking up fuel continuity in future fires, and restoring natural frequent fire processes.

Increasing spatial and temporal heterogeneity.

Fire and forest structure interact such that the variability in stand structures present within a landscape influences the distribution of fire behaviors and severities, which in turn influence successional trajectories of post-fire environments.[263] The patchy mosaic patterns attributed to historic forest ecosystems were influenced by a range of fires and other disturbances through time and space – including patches of high-severity fire – that "*create coarse-grained, high-contrast heterogeneity…*[and]… *a complex mosaic of seral stages at the landscape and local scales*."[264] Fine scale, site-specific factors can produce dissimilar spatial patterns between sites in close proximity[265] in response to site characteristics, disturbance, successional pathways, and management history.[266]

Fire can create heterogeneity in ways that mechanical approaches simply cannot. A study of eleven mixed-severity Arizona fires across a sixteen year chronosequence described dramatic variability between fires in residual structure, regeneration response, snag and coarse woody debris dynamics, and future trajectories.[267] On the Rodeo-Chediski Fire in Arizona, Shive and colleagues observed that pre-fire treatments combined with mixed fire-severities to produce landscape heterogeneity that defied simple classification by burn severity.[268] On the same fire Owen and colleagues observed unexpected and paradoxical regeneration characteristics that included the highest documented rates of ponderosa pine regeneration occurring intermixed with the highest density of re-sprouting species in a plot far from the nearest pine seed-source.[269] These types of complex spatial arrangements of vegetative successional stages with variations in patch size and shape enhance biological diversity and influence future fire spread and

[263] Ziegler *et al.* 2017

[264] p. 310 in DellaSala *et al*. 2014. Complex early seral forests of the Sierra Nevada: what are they and how can they be managed for ecological integrity? *Natural Areas Journal* 34(3): 310-324.

[265] Rodman *et al.* 2016. Reference conditions and historical fine-scale spatial dynamics in a dry mixed-conifer forest, Arizona, USA. *Forest Science* 62: 268–280.

[266] Hessburg *et al.* 2015. Restoring fire-prone Inland Pacific landscapes: seven core principles. *Landscape Ecology* 30: 1805-1835.

[267] Roccaforte *et al.* 2012

[268] Shive *et al.* 2013

[269] Owen *et al.* 2017

behavior.[270] Diverse understory communities across a spectrum of disturbance histories and successional trajectories may provide additional resilience to future climate-induced changes.[271]

High-severity burn patches in the Rodeo-Chediski Fire on the White Mountain Apache Reservation in Arizona have been found to have significantly higher forb species richness, total understory plant cover, and ponderosa pine regeneration compared to low-severity areas.[272] A high-intensity escaped prescribed fire in a ponderosa pine dominated mixed-conifer forest at Grand Canyon National Park led to a dramatic increase in understory native plant cover, species richness, and composition.[273] Naturally recovering high-severity burn patches within mixed-severity mosaics have increased plant diversity and may be more resilient to future climate stress.[274]

The contemporary fire crisis is not so much predicated on high-severity fire being inherently "bad," but that the scale of patches exceeds what would have historically occurred. Determining the appropriate scale and frequency of fire-induced patch disturbance is an important step towards harnessing the efficacy of fire to achieve restoration objectives.

Promoting complex early-successional ecosystems

Early-successional forest ecosystems possess high structural complexity, spatio-temporal heterogeneity, and biological/foodweb diversity resulting from variability in disturbance severity, environmental conditions, and surviving trees.[275] Patches of moderate to high-severity fire can produce highly spatially variable forest structures as a response to uneven burn effects and patchy mortality dynamics.[276] Tree regeneration patterns in early-successional habitats reflect favorable environmental conditions[277] and variable thinning by fire and other

[270] Teske *et al.* 2012

[271] Halofsky *et al.* 2011. Mixed- severity fire regimes: lessons and hypotheses from Klamath-Siskiyou Ecoregion. *Ecosphere* 2(4): art40.

Hurteau *et al.* 2014. Climate change, fire management, and ecological services in the southwestern US. *Forest Ecology and Management* 327: 280-289.

[272] Shive *et al.* 2013

[273] Huisinga *et al.* 2005. Effects of an intense prescribed fire on understory vegetation in a mixed conifer forest. *Journal of the Torrey Botanical Society* 32(4): 590-601.

[274] Hunter *et al.* 2011; Owen *et al.* 2017

[275] Swanson *et al.* 2011. The forgotten stage of forest succession: early-successional ecosystems on forest sites. *Frontiers in Ecology and the Environment* 9(2): 117-125.

[276] Fulé *et al.* 2004. Effects of an intense prescribed forest fire: is it ecological restoration? *Restoration Ecology* 12(2): 220–230.

[277] Savage *et al.* 1996. The role of climate in a pine forest regeneration pulse in the southwestern United States. *Ecoscience* 3(3): 310-318.

disturbance.[278] These areas of localized disturbances create valuable wildlife habitat[279] and provide opportunities to apply additional fire treatments which promote further spatial diversity.[280]

The common attributes of complex early seral forests include:[281]

•Abundant and widely distributed large trees, snags and downed logs

•Varied and rich understory flora

•Varied and rich floral invertebrate, avian and mammalian species composition

•Highly complex structural complexity with many biological legacies

•Complex and functional below-ground biological processes

•Complex and varied genetic diversity

•Rich ecosystem processes including pollination and predation

•Low susceptibility to invasive species

•Varied and complex disturbance frequency

•High landscape integrity with shifting mosaics and disturbance dynamics

•High resilience and resistance to climate change due to varied and complex genomes

Haire and McGarigal studied high-severity burn patches at Saddle Mountain (Kaibab Plateau, Arizona; burned in 1960) and La Mesa (Pajarito Plateau, New Mexico; burned in 1977), both of which share similar soils, topography, and vegetative communities as the Project landscape. The purpose of their research was to "*better understand plant succession after severe fire events in the southwestern United States, given the possibility that these landscapes occupy an important place in long-term variability of ecosystems.*"[282] Fifty-two species of native trees and shrubs, arranged along dynamic spatially and temporally influenced gradients, were documented at the two sites. Distance from edge-of-burn was strongly correlated to prevalence of resprouting species (generally shrubs, including oaks) over off-site seeders (generally coniferous trees), and was influenced by conditions in the pre-fire landscape. However, evidence of continued tree establishment and succession was evident decades post-fire as environmental conditions permitted tree establishment.

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[278] Holden *et al.* 2007

[279] Halofsky *et al.* 2011; Hunter *et al.* 2011

[280] Williams *et al.* 2010

[281] p. 314 in DellaSala *et al.* 2014

[282] p. 147 in Haire and McGarigal 2008

The early-successional habitats encountered by Haire and McGarigal led to their conclusion that:

> *"Areas burned in severe fire at Saddle Mountain and La Mesa included communities that might diversify function of landscapes through creation of early successional habitats for wildlife. In addition, woody species at the study sites have a wide range of traditional and current uses; basketry and other building material important food sources, a plethora of medicinal remedies, and ceremonial uses in contrast to studies that emphasize undesirable effects when forests transition to openings and alternative habitats, our research elucidates the need for further consideration of both young forest communities, and the persistent species and communities described as landscape scars, in conservation plans for forest systems of the southwestern United States."*[283]

Recent work by Owen and colleagues at the Rodeo-Chediski and Pumpkin Fires confirmed ponderosa pine establishment > 300m from nearest seed source in spatial arrangements that were indistinguishable from forest-edge locations regardless of presence of sprouting woody species, suggesting forest recovery was in fact occurring.[284] Unfortunately, complex early seral forests are poorly understood in southwestern dry forests as reference site studies and stand reconstructions characteristically cannot account for small diameter trees and other small vegetation. In order to maintain biodiversity and support landscape heterogeneity it is imperative that scientists initiate more research on these ephemeral habitats in dry southwestern forests in order to account for their contribution in ecosystem management.[285] Meaningfully increasing the use of prescribed and wildland fire for ecological restoration requires recognition of the benefits of mixed fire severities in shrub, woodland and forested ecosystems. Based on the information presented above, small patches of high-severity fire effects interspersed within a matrix of low and moderate-severity can meet restoration objectives, create important ephemeral habitats, and reduce the risk of uncharacteristic reburn potential.

A Strategic Treatments for Fire Use Alternative meets the project Purpose and Need

Repeated fire application in prescribed and managed wildfire settings is needed and reflects the best available science. The objective of ecological restoration in southwestern fire-adapted forests is to restore resilience to the inevitable future fires that will come, regardless of climate, environmental or human influences.[286] A number of fires have occurred across the Project landscape that can be leveraged for additional gains in fuels reduction and ecosystem restoration. It's a lost opportunity to not follow recent prescribed, resource benefit, and uncontrolled wildfires with additional fire, knowing that past fires act as fuel breaks and that effect diminishes

[283] p. 159 in Haire and McGarigal 2008

[284] Owen *et al.* 2017

[285] Swanson *et al.* 2011

[286] Allen *et al.* 2002

Schoennagel *et al.* 2017. Adapt to more wildfire in western North American as climate changes. *PNAS* doi/10.1073/pnas.1617464114.

with time.[287] It is critical to remember that "*historical … forest structure was a product of not one but of a series of fires over time.*"[288] The compounding effect of recurring fire through centuries was selection for functional traits that incur ecophysiological adaptive benefits for drought and fire tolerance.[289] Overlapping fire mosaics promote development of differential tree recruitment, increase structural diversity and successional pathways, and break up fuel beds, facilitating more beneficial fires in the future.[290]

Holden and colleagues, in an analysis of thirteen fires in the Gila and Aldo Leopold Wilderness areas found evidence that initial wildfire severity slightly influenced severity of subsequent fires. In that study, which did not provide information for the size or distribution of burn patches, initial high-severity burns frequently reburned at high-severities, but most often in moist, high-elevation sites. The authors ultimately concluded that satellite imagery must be interpreted carefully and that field verification of their sites was needed.[291] Later work provided a contrasting conclusion, that previous wildfires do in fact moderate the severity of subsequent fires and lead to proportionally more area burned at low-severity.[292]

Returning frequent fire to the landscape will continue to alter forest structure and composition in ways that are not yet fully known, especially for wildlife that utilize snags and coarse woody debris.[293] Consistently, however, research from throughout the western United States alludes to the efficacy of returning fire in a mixed-severity approach, and following up with repeated low-severity burning for restoring historical structure, pattern, and process.[294] Modelling by Shive and colleagues showed that under milder climate scenarios, prescribed fire combined with climate-induced growth reductions resulted in ponderosa pine basal areas within the HRV[295], consistent with field observations of fire-based restoration at Grand Canyon and the Gila Wilderness, described below.

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[287] Parks *et al.* 2015

[288] p. 118 in Hunter *et al.* 2011

[289] Strahan *et al*. 2016. Shifts in community-level traits and functional diversity in a mixed conifer forest: a legacy of land-use change. *Journal of Applied Ecology*, doi: 10.1111/1365-2664.12737.

[290] Teske *et al.* 2012

[291] Holden *et al*. 2010. Burn severity of areas reburned by wildfires in the Gila National Forest, USA. *Fire Ecology* 6(3): 77-85.

[292] Parks *et al*. 2014. Previous fires moderate burn severity of subsequent wildland fires in two large western US wilderness areas. *Ecosystems* 17: 29-42.

[293] Holden *et al*. 2006. Ponderosa pine snag densities following multiple fires in the Gila Wilderness, New Mexico. *Forest Ecology and Management* 221: 140–146.

[294] Hunter *et al.* 2011

[295] Shive *et al*. 2014. Managing burned landscapes: evaluating future management strategies for resilient forests under a warming climate. *International Journal of Wildland Fire* 23: 915–928

Repeated summer wildfires since 1946 at in the Gila and Saguaro Wilderness areas have successfully reduced density of small-diameter trees while not affecting large tree density, effectively shifting towards a larger tree distribution while reducing risk of crown fire, increasing resilience, and creating desired structural heterogeneity.[296] Similar effects have been documented on the Hualapai Indian Reservation, where more than fifty years of frequent prescribed fires have increased resilience to crown fire and climate change near the lower elevational limit of ponderosa pine.[297]

Repeated mixed-severity prescribed and natural-ignition fires in ponderosa pine dominated forests at Grand Canyon National Park have been shown to limit large tree mortality, reduce density of conifer seedlings and shade tolerant understory saplings, and reduce surface fuels consistent with restoration objectives and managing for climate resilience.[298] Initial mortality pulses resulting from initial fire entry create numerous snags, but many are consumed upon fire reentry as snag recruitment and persistence reaches a possible equilibrium.[299]

Studying the effects of prescribed fires on burn severity in the Rodeo-Chediski Fire, Finney and colleagues found that areas which were repeatedly burned significantly reduced subsequent burn severity, but the beneficial effects diminished with time since fire. Their observations of fire progression, captured via satellite, provided evidence "*consistent with model predictions that suggest wildland fire size and severity can be mitigated by strategic placement of treatments.*"[300] Researchers observed the same effect studying fires in New Mexico and Idaho, where the "*severity of reburns increases with time since the previous fire, likely due to biomass accumulation associated with longer fire-free intervals.*"[301] Although their data showed that previous fires did have an effect up to 22 years later, further study concluded that initial fires ability to act as a fuel break was as little as 6 years in warm/dry climates such as southwestern ponderosa pine forests.[302]

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[296] Holden *et al.* 2007

[297] Stan *et al*. 2014. Modern fire regime resembles historical fire regime in a ponderosa pine forest on Native American lands. *International Journal of Wildland Fire* 23: 686-697.

[298] Fulé *et al*. 2002. Natural variability in forests of the Grand Canyon, USA. *Journal of Biogeography* 29: 31-47.

Fulé and Laughlin 2007. Wildland fire effects on forest structure over an altitudinal gradient, Grand Canyon National Park, USA. *Journal of Applied Ecology* 44: 136-146.

Laughlin *et al*. 2011. Effects of a second-entry prescribed fire in a mixed conifer forest. *Western North American Naturalist* 71(4): 557-562; and Fulé *et al.* 2004

[299] Holden *et al.* 2006; Laughlin *et al.* 2011

[300] p. 1714 in Finney *et al*. 2005. Stand- and landscape-level effects of prescribed burning on two Arizona wildfires. *Canadian Journal of Forest Research* 35: 1714-1722.

[301] p. 38 in Parks *et al.* 2014

[302] Parks *et al.* 2015

Repeated resource objective fires on the Kaibab National Forest were recently reported to be more effective at restoring desired structure when they burned at moderate-severity under active fire-weather conditions.[303] Collins and Stephens found that in two Sierra Nevada wilderness areas where fire use policies were adopted, contemporary low-severity fires had allowed forests to become more resistant to insects, drought, and disease despite not having been thinned to historical densities. They concluded that "*what may be more important than restoring structure is restoring the process of fire*…[which] *could be important in allowing these forests to cope with projected changes in climate.*"[304]

Collins and colleagues studied mixed conifer forests in Yosemite National Park (4,800 - 7,000 ft.) where up to seven management and lightning started fires burned between 1983 and 2009, following an approximately 80-year fire-free period. They found that recent low severity fires reduced surface fuels and understory trees but did not kill enough intermediate sized trees to move towards desired structural characteristics. Their findings indicated "*no significant differences between current forest structure in areas that burned recently with moderate severity and forest structure in 1911*"[305] which was the year that historical inventory data was available for, and that only moderate fire-severity could substantially alter the ratio of fir to pine trees.

Taylor reported that two late twentieth century fires in an old growth ponderosa pine-Kellogg oak forest in California's Ishi Wilderness were effective at restoring pre-fire-exclusion structural characteristics, including composition, density, basal area and spatial pattern.[306] Similar effects were reported by Larson and colleagues, where reintroduction of natural-ignition fire in the Bob Marshall Wilderness of Montana has restored low-density mixed conifer forest dominated by large, old ponderosa pine by consuming surface fuels and thinning shade-tolerant species from the forest understory and mid-canopy.[307]

These studies support the concept that repeated fires will move ponderosa pine and dry mixed-conifer systems towards predominantly low-severity fire equilibrium, consistent with the body of work focused on frequent fire systems achieving a self-regulating state.[308] The consistent theme is that a mixed-severity initial fire entry creates conditions conducive to repeat burning at low

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[303] Huffman *et al*. 2017b. Restoration benefits of re-entry with resource objective wildfire on a ponderosa pine landscape in northern Arizona, USA. *Forest Ecology and Management* 408: 16-24.

[304] pp. 526-527 in Collins and Stephens 2007. Managing natural wildfires in Sierra Nevada wilderness areas. *Frontiers in Ecology and the Environment* 5(10): 523–527.

[305] p. 10 in Collins *et al*. 2011. Impacts of fire exclusion and recent managed fire on forest structure in old growth Sierra Nevada mixed-conifer forests. *Ecosphere* 2(4): 1-14.

[306] Taylor 2010. Fire disturbance and forest structure in an old-growth Pinus ponderosa forest, southern Cascades, USA. *Journal of Vegetation Science* 21: 561-570.

[307] Larson *et al*. 2013. Latent resilience in ponderosa pine forest: effects of resumed frequent fire. *Ecological Applications* 23(6): 1243–1249.

[308] Miller and Aplet 2015. Progress in Wilderness Fire Science: Embracing Complexity. *Journal of Forestry* 113: 1-11; and Parks *et al.* 2014; Parks *et al.* 2015

and moderate severities within the historical fire regime.[309] By allowing for moderate sized patches of high mortality that do not generally exceed 100 to 200 hectares (where determined appropriate by optimization analysis), there is relatively little risk of high-severity re-burning, inadequate regeneration, excessive coarse woody debris loadings, or transition to non-forest types.

Because of a reliance on unproven logging treatments, the proposed action will likely produce significant harmful impacts to Mexican spotted owl habitat across a large area with an unusually high concentration of PACs. To avoid unnecessary disturbance and habitat loss, and to ensure the most effective reduction in stand replacing fire risk, a vigorous treatment prioritization is necessary. The 2012 MSO Recovery Plan (at page 262) states that:

> "*As a general guide, forest management programs in PACs should…conduct a landscape-level risk assessment to strategically locate and prioritize mechanical treatment units to mitigate the risk of large wildland fires while minimizing impact to PACs.*"

This idea is expanded on later in the Recovery Plan (page 288):

> *"Treatments should be placed strategically to minimize risk of high-severity fire effects to the nest core while mimicking natural mosaic pattern. Emphasize treatments in other forest and woodland types over those of PACs and recovery habitats to the extent practicable. Treatments in these areas might buffer owl habitat as well as provide fire risk reduction to WUI communities. Where appropriate, areas surrounding PACs could be treated with higher prescribed fire and mechanical treatment intensities to better achieve management objectives (e.g., reduction of hazardous fuels and potential for stand-replacing fires, enhancement of landscape, and forest structural diversity)".*

Strategically locating and prioritizing mechanical treatments, rather than seeking to treat large expanses, is also an important component of recovering the MSO at the EMU scale because of limitations of the percentage of PACs that are to be treated across the EMU during the 10 year course of the Recovery Plan.

A Strategic Treatments for Fire Use Alternative is significantly distinguishable from the proposed action

The Strategic Treatments for Fire Use Alternative is significantly distinguishable from the proposed action in that:

• It identifies mechanical treatments areas primarily on the basis of where treatments can have the most effect on fire behavior and thus permit fire-based restoration in a scientifically derived

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[309] Laughlin and Fule 2006. Meeting forest ecosystem objectives with wildland fire use. *Fire Management Today* 66(4): 21-24.

way, rather than identifying treatment areas on the basis of what structure does not meet the desired structural conditions as established in GTR-310.

• It reduces logging impacts to Mexican spotted owl habitat by identifying strategically placed treatment priority areas and allowing natural mixed-severity fire-processes to interact with owl habitat in response to climate and topography, consistent with the co-evolution of spotted owls and fire-adapted forests.[310]

A Strategic Treatments for Fire Use Alternative should implement a Travel Analysis Report & Minimum Road System

The Forest Service faces many challenges with its oversized, under-maintained, and unaffordable road system. The impacts from roads to water, fish, wildlife, and ecosystems are well documented in scientific literature. And the impacts to communities are felt when continued deferred maintenance leads to more washouts and road closures from winter storms. The Santa Fe National Forest is no exception with thousands of miles of system roads, the required maintenance of which exceeds annual maintenance budgets.

To address its unsustainable and deteriorating road system, the Forest Service promulgated the Roads Rule (referred to as "subpart A") in 2001.[311] The Roads Rule created two important obligations for the agency. One obligation is to identify unneeded roads to prioritize for decommissioning or to be considered for other uses.[312] Another obligation is to identify the minimum road system needed for safe and efficient travel and for the protection, management, and use of National Forest system lands.[313] Pursuant to Washington Office guidance, the national forests completed travel analysis reports in September of 2015. The next step under subpart A is to consider the valid portions of the travel analysis report and begin to identify and implement the minimum road system in its analysis of site-specific projects of the appropriate geographic size under NEPA.[314] National and regional guidance directs this to happen through analysis of site-specific projects of the appropriate geographic size under NEPA.[315]

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[310] Ganey, J.L., H.Yi Wan, S.A. Cushman, And C.D. Vojta. 2017. Conflicting Perspectives on Spotted Owls, Wildfire, and Forest Restoration. Fire Ecology 13(3) doi: 10.4996/fireecology.130318020. (For example, Ganey et al. 2017 state that "*Treatments should be located strategically based on models of fire behavior and spread to optimize gains in reduction of fire risk relative to area treated*.")

[311] 66 Fed. Reg. 3206 (Jan. 12, 2001); 36 C.F.R. part 212, subpart A.

[312] 36 C.F.R. § 212.5(b)(2).

[313] *Id.* § 212.5(b)(1).

[314] *See* 2012 Weldon Memo 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").

[315] *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").

The minimum road system is the road system the Forest Service determines is needed to:[316]

- "*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*."

The Forest Service should identify the minimum road system for particular forest segments by analyzing whether a proposed project is consistent with the relevant portions of the travel analysis report and considering the minimum road system factors under 36 CFR 212.5(b)(1) for each road the agency decides to keep as part of the specific project.[317]

Given the large geographic scale of this project and the overarching purpose of this project, this is precisely the type of project where the Forest Service must consider its travel analysis report for the Forest Service and identify the minimum road system for the project area.[318] We urge the Forest Service to carefully evaluate the project and each of its alternatives through this lens. This type of large-scale project is the perfect opportunity to begin making on-the-ground progress towards an economically and environmentally sustainable road network.

Identifying a resilient future road network 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 drastically 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.

Close or Decommission Unneeded Roads

The Forest Service should consider all unneeded roads for closure or decommissioning. Subpart A of the Roads Rule also directs the agency to "*identify the roads on lands under Forest Service*

[316] 36 C.F.R. §212.5(b)(1).

[317] *Id.* ("The resulting decision [in a site-specific project] identifies the [minimum road system] and unneeded roads for each subwatershed or larger scale").

[318] 36 C.F.R. § 212.5(b)(1) ("For each national forest . . . the responsible official must identify the minimum road system needed for safe and efficient travel and for administration, utilization, and protection of National Forest System lands.").

jurisdiction that are no longer needed," and therefore should be closed or decommissioned.[319] The rule refers to all roads, not just National Forest System roads. The rules define a road as "[a] *motor vehicle travelway over 50 inches wide, unless designated and managed as a trail*."[320] 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 road decommissioning or closures is warranted.

Road decommissioning can 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 decommissioned.[321] 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 actions.

As forest road users and conservationists, we understand that a strategic reduction in road miles does not necessarily equate to a loss of access. Some roads are already functionally closed due to lack of use, natural vegetation growth, etc. Other roads receive limited use and are costly to maintain. Resources can be better spent on roads providing significant access than to spread resources thinly to all roads. This is why we support the careful analysis and decision to decommission or close specific roads, and urge the Forest Service to utilize this opportunity to identify and implement a minimum road system in the project area.

In addition to the science-based optimization design criteria described above, the Strategic Treatments for Fire Use Alternative implements elements which make it distinctive from the proposed action:

► The Strategic Treatments for Fire Use Alternative adopts the NM Forest Restoration Principles as guiding principles.

► The Strategic Treatments for Fire Use Alternative analyzes the effects of livestock grazing on the success of the proposed vegetation treatments in achieving and maintaining desired future conditions as they relate to fire use, migratory bird, native fish and other sensitive species populations and habitats.

► The Strategic Treatments for Fire Use Alternative identifies areas with degraded soils or plant communities, areas with sensitive or high-erosion soils, and areas in need of recovery, and reduce or eliminate grazing in those pastures altogether to contribute to the success of resiliency treatments.

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[319] 36 C.F.R. § 212.5(b)(2). *See also Center for Sierra Nevada*, 832 F. Supp. 2d at 1155 ("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.").

[320] 36 C.F.R. § 212.1.

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

► The Strategic Treatments for Fire Use Alternative permanently fences livestock out of all riparian areas.

► The Strategic Treatments for Fire Use Alternative allows only hand thinning in roadless and unroaded areas.

► The Strategic Treatments for Fire Use Alternative applies a Travel Analysis Report & Minimum Road System approach to analysis.

► The Strategic Treatments for Fire Use Alternative retains all existing old (>150 years) and large (>18" dbh) trees, and identifies and retains all old growth patches and stands.

► The Strategic Treatments for Fire Use Alternative adopts all recommendations of the 2012 Mexican spotted owl Recovery Plan as project design features.

► The Strategic Treatments for Fire Use Alternative does not treat dwarf mistletoe with any special category of treatment, not does it seek to reduce dwarf mistletoe from current levels beyond what typical thinning and burning treatments would accomplish.

► The Strategic Treatments for Fire Use Alternative develops a robust multi-party monitoring framework built upon established triggers and responses.

► The Strategic Treatments for Fire Use Alternative utilizes locally-specific references conditions that usurp those described in GTR-310.

We respectfully invite the Forest Service to analyze our proposed alternative as a comparison to the agencies preferred course of action. We are confident that our alternative can accomplish the projects purposes of:

1. Moving frequent-fire forests in the Project Area towards their characteristic species composition, structure and spatial patterns in order to improve ecological function;

2. Creating conditions that facilitate the safe reintroduction of fire, allowing fire to play its natural role in frequent fire forest types;

3. Reducing the risk for large high-intensity wildfires, create safe, defensible zones for firefighters and minimize the risk of fire to nearby valued resources;

4. Improving and maintaining diverse wildlife habitats to provide a large array of habitat types, habitat components, seral stages and corridors for a variety of species that utilize the area; and

5. Improving watershed conditions by restoring the vegetative structure and composition of riparian ecosystems and by maintaining and improving water quality.

Any refusal to analyze this alternative must be accompanied by a detailed justification for why the alternative would not meet the project purpose, how our alternative is not distinguished from the agencies preferred alternative, and how the agencies preferred alternative includes the proposed elements of our alternative.

CONCLUSION

The proof of this Projects success in achieving restoration and resiliency will be in how individual actions are implemented, and if the emphasis in spending and staff time is focused on logging only, or if the full range of treatments are implemented along similar timeframes. We are interested in seeing how various restoration treatments are deployed, and look forward to making site visits to a range of sites to learn together from the results. Please consider organizing additional field trips as these are opportunities to refine management approaches based on shared understanding of treatment efficacy.

We appreciate your consideration of the information and concerns addressed in this letter, as well as the information included in the attachments which have been mailed on a thumb drive to the project email address. Should you have any questions, please do not hesitate to contact Mr. Trudeau at the number provided below.

Respectfully,

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