APPENDIX A – Previously Implemented Actions

The table below lists projects that were samples and analyzed to develop the proposed restoration categorical exclusion at 36 CFR 220.5(e)(26). An asterisk (*) in the Project Name and Location field indicates the project was subject to the questionnaire discussed in the Supporting Statement. An "X" in a Project Activity field indicates that the relevant NEPA documents did not specify acres or miles. The Project Activity columns correspond to activities listed under sections (i) and (ii) of the proposed categorical exclusion.

Project Name and Location	**Decision Notice Date**	**Project Activity Acres**						**Project Activity Miles**	
		(i)(8) Commercial Harvest	(i)(5)&(9) Thinning & Fuels Reduction	(i)(6) Prescribed Burning	(i)(7) Reforest	(i)(1)&(2) Habitat & Watershed	(i)(4) Invasive Species Control	(i)(3) Decommission Roads	(ii)(1)&(3) Construct Roads (Perm, Temp)
Arrowhawk Hazardous Fuels Reduction Project* *Humboldt-Toiyabe NF, Carson RD*	8/21/2012	878	2618	X		118	2900		
Bald Fire Salvage and Restoration *Lassen NF Forest-wide*	7/8/2015	8447		5499	12,200				
Barnyard South Sheep *Nez Perce-Clearwater NFs, North Fork RD*	7/8/2015	1590		X	860			75.6	0, 7.8
Bigelow-Newaygo Project* *Huron-Manistee NF, Baldwin/White Cloud RD*	9/30/2015	2256	952	1446			108		
Biggie Vegetation Management and Fuels Reduction Project *Tahoe NF, American River RD*	8/24/2016	1527	1008	256					
Black Locust Fuelwood *Huron-Manistee NF, Cadillac/Manistee RD*	1/6/2015	23	23	23			23		
Bucks Lake Hazardous Fuels Reduction Project *Plumas NF, Mt. Hough RD*	5/24/2012	1291	543	222					

Project Name and Location	Decision Notice Date	Project Activity Acres						Project Activity Miles	
		(i)(8) Commercial Harvest	(i)(5)&(9) Thinning & Fuels Reduction	(i)(6) Prescribed Burning	(i)(7) Reforest	(i)(1)&(2) Habitat & Watershed	(i)(4) Invasive Species Control	(i)(3) Decommission Roads	(ii)(1)&(3) Construct Roads (Perm, Temp)
Charlie Preston* *Idaho Panhandle NF, St. Maries RD*	2/6/2012	977	307	82	82	X		0.6	1.6, 0.4
Cherokee Park Project *Arapaho and Roosevelt NFs, Canyon Lakes RD*	5/26/2015	3124	2004					23.13	
Davy Crockett Red-cockaded Woodpecker Prescribe Burn Project *NFs in Texas, Davy Crockett RD*	4/3/2013			69,000			X		
Deep Creek Watershed Improvement Project *Caribou-Targhee NF, Westside RD*	9/15/2016			X		X	11		
Deer Pen Restoration Project *NFs in Alabama, Oakmulgee RD*	7/23/2014	408	128			X	7		0, 2.1
Dry Restoration* *Okanogan-Wenatchee NF, Naches RD*	2/6/2015	748				X			0, 3
East Wedge *Colville NF, Three Rivers RD*	6/25/2013	4976	695	4564					0, 3.6
Elkhorn Project *Arapaho and Roosevelt NFs, Canyon Lakes RD*	6/9/2014	2766		2191		X		24.56	0.26, 0
Escalante Forest Restoration Project* *Grand Mesa, Uncompahgre and Gunnison NFs, Ouray RD*	6/24/2013	10,525	11,625					X	

Project Name and Location	Decision Notice Date	Project Activity Acres						Project Activity Miles	
		(i)(8) Commercial Harvest	(i)(5)&(9) Thinning & Fuels Reduction	(i)(6) Prescribed Burning	(i)(7) Reforest	(i)(1)&(2) Habitat & Watershed	(i)(4) Invasive Species Control	(i)(3) Decommission Roads	(ii)(1)&(3) Construct Roads (Perm, Temp)
French Fire Recovery and Reforestation Project *Sierra NF, Bass Lake RD*	8/26/2015	3387	221		3000		32		0, 2.5
Gooseberry Ecological Restoration *Stanislaus NF, Summit RD*	5/8/2013	2246	126	2271			X	X	
Gordon Hill Vegetation Management Project *Six Rivers NF, Gasquet RD*	6/15/2015	1466	1188	95					0, 2.8
Grass Flat Hazardous Fuels Reduction and Forest Health Restoration Project *Plumas NF, Feather River RD*	9/26/2012	200	1145	107	83	X			
Grizzly Fire Salvage and Restoration *Idaho Panhandle NF, Wallace RD*	6/30/2016	3025			1837				0, 5
Hams Fork Vegetation *Bridger-Teton NF, Kemmerer RD*	9/11/2013	7892		730					0, 4
Hopkins Prairie Fire Salvage EA* *NFs in Florida, Lake George RD*	5/9/2013	1000							
Interior Vegetation Management Project* *Ottawa NF, Watersmeet RD*	7/24/2014	16,638	106	3312		829		66	9, 5
Iron Springs Vegetation Improvement and Salvage Project* *Dixie NF, Escalante RD*	3/8/2013	4121	769		154				0, 9.6

Project Name and Location	Decision Notice Date	Project Activity Acres						Project Activity Miles	
		(i)(8) Commercial Harvest	(i)(5)&(9) Thinning & Fuels Reduction	(i)(6) Prescribed Burning	(i)(7) Reforest	(i)(1)&(2) Habitat & Watershed	(i)(4) Invasive Species Control	(i)(3) Decommission Roads	(ii)(1)&(3) Construct Roads (Perm, Temp)
Julius Park Vegetation Management Project *Ashley NF, Vernal RD*	5/23/2013	675	89						0, 1
Junction Vegetation Management Project *Deschutes NF, Bend/Fort Rock RD*	6/30/2015	8964	12280	5738					
Keola Fuels and Forest Heath *Sierra NF, High Sierra RD*	12/8/2011	371	401	139	11				0, 1.5
Kidhaw Wildlife Habitat Improvement Project* *NFs in Texas, Sam Houston RD*	9/26/2013	560	545	820			X	0.6	0, 2
Larson Forest Restoration Project *Apache-Sitgreaves NFs, Black Mesa RD*	8/13/2015	24,574	1822	4906					
Lemon Butte Project Environmental Assessment *Umpqua NF, North Umpqua RD*	6/23/2016	603	43		55	X	X		0, 3.25
Lower Skokomish Vegetation Management Project *Olympic NF, Hood Canal/Hoodsport RD*	8/23/2016	4484					X	13.5	0, 5.2
Macedonia EA *Francis Marion and Sumter NFs, Francis Marion RD*	7/22/2014	8121				X			0, 4.5
Marshall Woods Restoration Project* *Lolo NF, Missoula RD*	1/28/2016	266	1178	1055	450	X		7.4	

Project Name and Location	Decision Notice Date	Project Activity Acres						Project Activity Miles	
		(i)(8) Commercial Harvest	(i)(5)&(9) Thinning & Fuels Reduction	(i)(6) Prescribed Burning	(i)(7) Reforest	(i)(1)&(2) Habitat & Watershed	(i)(4) Invasive Species Control	(i)(3) Decommission Roads	(ii)(1)&(3) Construct Roads (Perm, Temp)
Martin Creek Resource Management Project *Flathead NF, Tally Lake RD*	6/29/2015	774	338		929	X			3.1, 0.6
Middle Bugs *Nez Perce-Clearwater NFs, North Fork RD*	6/3/2013	705	114	642		X		3	0, 5.2
Millsteck *Allegheny NF, Marienville RD*	10/3/2012	1989		1673	2956	160	70		0.3, 0
Mitchell Spring Vegetation Improvement Project *Dixie NF, Escalante RD*	12/10/2015	771	626	X	108				0, 1.92
Morrison Run *Allegheny NF, Bradford RD*	5/2/2012	1401	536	370	451	X	442	3.4	1.1, 0
Mower Tract Restoration *Monongahela NF, Greenbrier RD*	9/28/2016		6358			54			0.8, 0
North Heber Salvage Project* *Uinta-Wasatch-Cache NF, Heber-Kamas RD*	6/5/2015	3730						47	
North Shore Restoration Project *Superior NF, Gunflint RD*	8/22/2014	3190	3785	20				1	0, 13.3
Ocala Fuel Reduction Mowing *NFs in Florida, Lake George RD*	3/6/2012		352						
Pine Ridge Landscape Restoration Project *Nebraska NF, Pine Ridge RD*	1/12/2015	7496	10,972	12,708	400	1168			
Pipeline Northwest Restoration Plan *NFs in Alabama, Oakmulgee RD*	8/11/2015	1944	925		461				0, 1.8

Project Name and Location	Decision Notice Date	Project Activity Acres						Project Activity Miles	
		(i)(8) Commercial Harvest	(i)(5)&(9) Thinning & Fuels Reduction	(i)(6) Prescribed Burning	(i)(7) Reforest	(i)(1)&(2) Habitat & Watershed	(i)(4) Invasive Species Control	(i)(3) Decommission Roads	(ii)(1)&(3) Construct Roads (Perm, Temp)
Red Hill Restoration *Shasta-Trinity NF, Yolla Bolla RD*	5/29/2013	1448	88					12	0, 4
Reedy Timber Sale Project *Francis Marion and Sumter NFs, Long Cane RD*	7/30/2013	1275							0, 0.3
Renshaw Vegetation Management Project EA* *Colville NF, Sullivan RD*	4/14/2015	4970	457	663				7	3, 10
Roy Creek *Huron-Manistee NF, Huron Shores RD*	9/8/2016	2550	865	5582			200	1.7	0, 7.5
Sagehen Project *Tahoe NF, Truckee RD*	5/6/2013		2627	2350				1	
Salmon West* *Allegheny NF, Marienville RD*	9/26/2013	2529	819		1684	X	188	3.9	8.5, 0
Sandbox Vegetation Management *Wallowa-Whitman NF, La Grande RD*	2/24/2014	2185	2097	7465				1.8	0, 4.4
Shores *Hiawatha NF, St. Ignace RD*	12/19/2011	1460	117				X	11	6.3, 2
Smith Mountain Project* *Ouachita NF, Caddo RD*	11/15/2011	3032	2781	8970	572	X	50		0, 8
Soldier Bay Analysis Area *NFs in Florida, Wakulla RD*	7/18/2016	2062	1434		243				0, 1
South Bridger Interface Project EA *Custer Gallatin NF, Bozeman RD*	8/8/2014	250							0, 0.5

Project Name and Location	Decision Notice Date	Project Activity Acres						Project Activity Miles	
		(i)(8) Commercial Harvest	(i)(5)&(9) Thinning & Fuels Reduction	(i)(6) Prescribed Burning	(i)(7) Reforest	(i)(1)&(2) Habitat & Watershed	(i)(4) Invasive Species Control	(i)(3) Decommission Roads	(ii)(1)&(3) Construct Roads (Perm, Temp)
South Summit Forest and Fuels II* *Okanogan-Wenatchee NF, Methow Valley RD*	7/14/2015	2350	1000	6600				81.5	0.5, 0.4
Southern Creek Ouachita River *Ouachita NF, Mena RD*	9/17/2015	1838	835	5460	225	X			0, 5
Spring Gulch Timber Sale *Kootenai NF, Cabinet RD*	4/15/2013	256	66	229					
Sulphur Forest Restoration Project* *Cibola NF, Sandia RD*	9/2/2014	613		X					
Telogia Analysis Area *NFs in Florida, Wakulla RD*	8/11/2014	1631	77						0, 0.6
Toll Joe *Willamette NF, Sweet Home RD*	6/6/2014	944	139						0, 4
Upper Lake Winona *Ouachita NF, Winona RD*	7/19/2016	2965	8097	15,959	1555	X			0, 14
Upper South Fork Skokomish Vegetation Management Project *Olympic NF, Shelton RD*	3/5/2013	880						2.6	0, 0.9
Watson Hill LLC Vegetation Management and Timber Sale Project *Francis Marion and Sumter NFs, Long Cane RD*	6/30/2015	8116	268						0, 2.8

Project Name and Location	Decision Notice Date	Project Activity Acres						Project Activity Miles	
		(i)(8) Commercial Harvest	(i)(5)&(9) Thinning & Fuels Reduction	(i)(6) Prescribed Burning	(i)(7) Reforest	(i)(1)&(2) Habitat & Watershed	(i)(4) Invasive Species Control	(i)(3) Decommission Roads	(ii)(1)&(3) Construct Roads (Perm, Temp)
West Slope Wildland-Urban Interface Hazardous Fuels Reduction Project *Manti-La Sal NF, Moab RD*	5/8/2015		4546						
Westside Collaborative Vegetation Management Project *Bitterroot NF, Darby RD*	7/5/2016	1349	978					2	3.8, 3.8
Windy Project *Superior NF, Tofte RD*	3/20/2015	2699	549	186				2.1	0, 9

Appendix B – Professional Staff and Experts

NAME	TITLE	EDUCATION	YEARS	AGENCIES	REGION(S)	EXPERTISE
Chris Carlson	Assistant Director, Water and Aquatic Resources	B.A. Physics, M.S. Environmental Science, M.S. Geology, Ph.D. Geological Science	12+ w/USFS 26+ professional	USFS	National	Hydrology, Geology (WI Lic Prof Hydrologist, WI Lic Prof Geologist)
Emilee Blount	Director Engineering Technology and Geospatial Services,	BS Civil Engineering , MS Administration	33	USFS, DoD	National	Engineering, Environmental, Logistics, Fleet
Eric Davis	Assistant Director, Integrated Vegetation Management, Forest and Range Management and Vegetation Ecology	BA Biology, MS Biology, MA National Security and Strategic Studies	28	USMC, USFWS, USFS	In USFS - National	Endangered Species, Environmental Management, Logistics

NAME	TITLE	EDUCATION	YEARS	AGENCIES	REGION(S)	EXPERTISE
Frank Fay	Applied Fire Ecologist	B.S. Forestry	33	USFS	Regions 4, 5, and 6, National	Fire, Fuels, Ecology, Planning, Silviculture, Climate Change, Remote Sensing, Risk Assessment
Sam Gaugush	Program Specialist, NEPA	J.D. University Oregon School of Law, B.A. Sociology and Spanish	10	USFS, BLM	National	NEPA, Environmental and Natural Resources Law, Administrative Law
James Menakis	National Fire Ecologist	B.S. Natural Resources, M.S. Environmental Studies	30	USFS	Rocky Mountain Research Station, National Fire and Aviation Management	Fire Ecology, Fuel Treatment Effectiveness, Wildfire Risk Assessments
John Exline	Director Ecosystem Management, Pacific Southwest Region	B.A. Biology, M.F. Forest Resource Management	37	USFS	Regions 5, 6, National	Forester, Sale Preparation, Management of National Forest Service System lands
Kris Stein	District Ranger	B.S. Recreation Resource Management, M.S. Forest Management	30	USFS	Regions 3, 4, 6, 9	Management of National Forest Service System lands, and NEPA implementation
Rob Gillespie	Assistant National Transportation Program Manager	B.S. Civil Engineering	8.5	FHWA USFS – NFS	National	Road Design, Construction, Policy, and Oversight
Steve Kuennen	Direction Renewable Resources, Eastern Region	B.S. Natural Resource Management	20	USFS, Menominee Indian Tribe	Regions 1, 2, 6, 8, 9	Forester, Sale Preparation, Sale Administration, Silviculture

NAME	TITLE	EDUCATION	YEARS	AGENCIES	REGION(S)	EXPERTISE
Tera Little	NEPA Specialist	B.A. Communication	11	USFS - NFS	National, Regions 1, 3 and 4	Environmental Compliance (NEPA)

Appendix C – Select Research Papers and Supporting Documents

RESEARCH PAPER, AUTHORS, PUBLICATION	Findings Summary
Basic principles of forest fuel reduction treatments; Agee, James, and Carl Skinner; Forest Ecology and Management, Vol 211, Issues 1–2 (2005) 83-96	This paper focuses on the drier forests that are in need of active management to mitigate fire hazard. The paper summarizes a set of simple principles important to address in fuel reduction treatments: reduction of surface fuels, increasing the height to live crown, decreasing crown density, and retaining large trees of fire-resistant species. Thinning and prescribed fire can be useful tools to achieve these objectives. Low thinning will be more effective than crown or selection thinning, and management of surface fuels will increase the likelihood that the stand will survive a wildfire. Applying treatments at an appropriate landscape scale will be critical to the success of fuel reduction treatments in reducing wildfire losses in Western forests.
The effects of three regeneration harvest methods on plant diversity and soil characteristics in the southern Appalachians; Elliott, Katherine and Jennifer Knoepp; Forest Ecology and Management, Vol 211, Issue 3 (2005) 296-317	This paper evaluated the effects of three regeneration harvest methods on plant diversity and soil resource availability in mixed hardwood ecosystems based on species diversity of overstory, understory, and herbaceous layer species was evaluated using species richness (S), Shannon–Wiener's index of diversity (H0), and Pielou's evenness index (E). The conclusion found an increase in average distance in the NMS ordination among sites in 2000 compared to 1994, which suggests greater herbaceous species diversity after harvest. However, the authors did not see a clear separation among harvest treatments in the NMS ordination.
The effects of harvest-created gaps on plant species diversity, composition, and abundance in a Maine oak–pine forest; Schumann, Martha, Alan White, and Jack Witham; Forest Ecology and Management, Vol 176, Issues 1–3 (2003) 543-561	This paper evaluates the effects of harvest-created gaps and soil moisture (as reflected by soil drainage classes) on woody and herbaceous species diversity, composition, and abundance relative to unharvested control areas. Because the vegetation was sampled in both 1993 and 1998, detection of short-term changes was possible. Conclusion: From a silvicultural perspective, the harvest gaps created sites for establishment of seedlings and sprouts of tree species, particularly early successional species. The creation of gaps met a primary objective of the harvest, to increase white pine and red oak regeneration. Silvicultural practices seeking to incorporate natural disturbances should retain late successional characteristics within managed forests (Hunter, 1990). The group-selection harvest at the HRF, while introducing early successional species, maintained late successional species as well.

RESEARCH PAPER, AUTHORS, PUBLICATION	Findings Summary
Effects of thinning on soil and tree water relations, transpiration and growth in an oak forest; Bréda, N, A. Granier, and G. Aussenac; Tree Physiology, Vol 15, Issue 5 (1995) 295–306	This paper quantifies the effects of crown thinning on the water balance and growth of the stand and to analyze the ecophysiological modifications induced by canopy opening on individual tree water relations, the authors conducted a thinning experiment in a 43-year-old Quercus petraea stand by removing trees from the upper canopy level. Soil water content, rainfall interception, sap flow, leaf water potential and stomatal conductance were monitored for two seasons following thinning. Seasonal time courses of leaf area index (LAI) and girth increment were also measured. Thinning increased inter-tree variability in sap flow density, which was closely related to a leaf area competition index. Stomatal conductance varied little inside the crown and differences in stomatal conductance between the treatments appeared only during a water shortage and affected mainly the closed stand. Thinning enhanced tree growth as a result of a longer growing period due to the absence of summer drought and higher rates of growth. Suppressed and dominant trees benefited more from thinning than trees in the codominant classes.
Salvage harvest effects on advance tree regeneration, soil nitrogen, and fuels following mountain pine beetle outbreak in lodgepole pine; Griffin, Jacob, Martin Simard, and Monica G. Turner; Forest Ecology and Management Volume 291 (2013) 228–239	This paper studies how post-outbreak timber harvest (i.e., salvage harvest) could alter future forest development, productivity and susceptibility to subsequent disturbance. This study suggests that merchantable trees can be harvested from some beetle-killed lodgepole pine forests without severely compromising potential tree regeneration and without large initial effects on soil N. This study also suggests that the window of time in which salvage harvest could reduce post-outbreak canopy fuels compared to untreated stands is short. The longer salvage harvest is delayed after beetle attack, the less effective the treatment will be for reducing canopy fuels because the red stage is ephemeral, and available canopy fuels are progressively shed from beetle-killed trees.
2016-2017 Gambel Oak Understory Study Summary; Chambers, Marin and Jeff Cannon; Colorado Forest Restoration Institute, Colorado State University, CFRI-1801, January 2018	This paper describes how Gambel oak treatments such as cutting, mowing, and prescribed fire influence Gambel oak growth and understory vegetation, particularly for the purposes of improving wildlife habitat and browse potential and to better inform the effectiveness of treatments in Gambel oak on the western slope of Colorado.
Effects of forest restoration treatments and wildfires on tree spatial patterns in the Colorado Front Range; Cannon, Jeffery, Jennifer Briggs, and Marin Chambers; 7th International Fire Ecology and Management Congress, Research Highlight, December 2017	Research study on how restoration treatments alter fine-scale forest spatial patterns and compare these outcomes to those from low- to moderate severity portions of wildfires. Conclusion: Both mechanical restoration treatments and low- and moderate severity portions of wildfires enhance the spatial mosaic present in forests by increasing coverage, size, and variability of gaps; Low- and moderate severity portions of wildfires resulted in lower canopy cover and higher gap cover than the majority of restoration treatments.
Hydrologic responses to restored wildfire regimes revealed by soil moisture vegetation relationships; Gabrielle Boisramé, Sally Thompson, Scott Stephens; Advances in Water Resources 112 (2018) 124-146	Restoration of pre-suppression forest composition and structure through a variety of management activities could improve forest resilience and water yields. The study explores the potential for "managed wildfire", whereby naturally ignited fires are allowed to burn, to alter the water balance. Little change in basin-averaged soil moisture was inferred due to managed wildfire, but the results indicated that large localized increases in soil moisture had occurred, which could have important impacts on local ecology or downstream flows.

RESEARCH PAPER, AUTHORS, PUBLICATION	Findings Summary
Effects of thinning on drought vulnerability and climate response in north temperate forest ecosystems; D'Amato, Anthony, John Bradford, Shawn Fraver, and Brian Palik; Ecological Applications, Vol 23, Issue 8 (2013) 1735-1742	This study provides a critical evaluation of the long-term effectiveness of tree density management at reducing drought impacts and illustrates that the relative effectiveness of such strategies may vary depending on long-term thinning history. Findings underscore the utility of tree density reductions (via silvicultural thinning) for reducing drought vulnerability. Thinning should be viewed as a near-term solution to reducing drought vulnerability relative to longer term approaches aimed at increasing the functional diversity of forest tree communities, including greater representation of drought tolerant species.
Fuel treatment effects on tree-based forest carbon storage and emissions under modeled wildfire scenarios; Hurteau, Matthew and Malcolm North; Frontiers in Ecology and the Environment, Vol 7, Issue 8 (2009) 409-414	This paper addresses how to manage forests with frequent fire regimes to maximize carbon storage while reducing carbon emissions from prescribed burns or wildfire. Hurteau and North modeled the effects of eight different fuel treatments on tree-based carbon storage and release over a century, with and without wildfire. Model runs show that, after a century of growth without wildfire, the control stored the most carbon. However, when wildfire was included in the model, the control had the largest total carbon emission and largest reduction in live-tree-based carbon stocks. In model runs including wildfire, the final amount of tree-based carbon sequestered was most affected by the stand structure initially produced by the different fuel treatments. In wildfire-prone forests, tree-based carbon stocks were best protected by fuel treatments that produced a low-density stand structure dominated by large, fire-resistant pines.
Fuel treatments alter the effects of wildfire in a mixed-evergreen forest, Oregon, USA; Raymond, Crystal and David Peterson; Canadian Journal of Forest Research, 35(12) (2005) 2981-2995	A rare opportunity to quantify the relationship between fuels and fire severity using prefire surface and canopy fuel data and fire severity data after a wildfire. The potential for crown fire initiation remained fairly constant despite reductions in ladder fuels, because thinning increased surface fuels, which contributed to greater surface fire intensity. Thinning followed by underburning reduced canopy, ladder, and surface fuels, thereby decreasing surface fire intensity and crown fire potential. However, crown fire is not a prerequisite for high fire severity; damage to and mortality of overstory trees in the wildfire were extensive despite the absence of crown fire. Mortality was most severe in thinned treatments (80%–100%), moderate in untreated stands (53%–54%), and least severe in the thinned and underburned treatment (5%). Fuel treatments intended to minimize tree mortality will be most effective if both ladder and surface fuels are treated.
The use of shaded fuelbreaks in landscape fire management; Agee, James, Berni Bahro, Mark Finney, Philip Omi, David Sapsis, Carl Skinner, Jan van Wagtendonk, C Phillip Weatherspoon; Forest Ecology and Management, Vo 127, Issues 1–3 (2000) 55-66	Landscape-level treatments such as prescribed fire can use shaded fuelbreaks as anchor points, and extend the zone of altered fire behavior to larger proportions of the landscape. Coupling fuelbreaks with area-wide fuel treatments can reduce the size, intensity, and effects of wildland fires.

RESEARCH PAPER, AUTHORS, PUBLICATION	Findings Summary
The ecology of mixed severity fire regimes in Washington, Oregon, and Northern California; Perry, David, Paul Hessburg, Carl Skinner, Thomas Spies, Scott Stephens, Alan Henry Taylor, Jerry Franklin, Brenda McComb, Greg Riegel; Forest Ecology and Management, Vol 262, Issue 5 (2011) 703-717	This paper addresses forests characterized by mixed-severity fires occupy a broad moisture gradient between lower elevation forests typified by low-severity fires and higher elevation forests in which high-severity, stand replacing fires are the norm. Mixed-severity regimes are produced by interactions between top-down forcing by climate and bottom-up shaping by topography and the flammability of vegetation, although specific effects may vary widely across the region, especially the relation between aspect and fire severity.
Return on investment from fuel treatments to reduce severe wildfire and erosion in a watershed investment program in Colorado; Jones, Kelly, Jeffery Cannon, Freddy Saavedra, Stephanie Kampf, Robert Addington, Antony Cheng, Lee MacDonal, Codie Wilson, Brett Wolk; Journal of Environmental Management, 198 (2017) 66-77	This paper used return on investment (ROI) analysis to quantify how the amounts and placement of fuel treatment interventions would reduce sediment loading to the Strontia Springs Reservoir in the Upper South Platte River watershed southwest of Denver, Colorado following an extreme fire event. A positive ROI after large storm events when fire mitigation treatments were placed in priority areas with diminishing marginal returns after treating >50-80% of the forested area. While analysis showed positive ROI focusing only on post-fire erosion mitigation, it is important to consider multiple benefits in future ROI calculations and increase monitoring and evaluation of these benefits of wildfire fuel reduction investments for different site conditions and climates.
Policy issues relevant to risk assessments, balancing risks, and the National Fire Plan: Needs and opportunities; O'Laughlin, Jay; Forest Ecology and Management, Vol 211, Issues 1–2 (2005) 3-14	The author discusses needs and opportunities for assessing and managing risks posed by wildfire through synthesis of natural resources agency and conservation group perspectives.
The effects of bark beetle outbreaks on forest development, fuel loads and potential fire behavior in salvage logged and untreated lodgepole pine forests; Collins, B.J.; Rhoades, C.C.; Battaglia, M.A.; Hubbard, R.M.; Forest Ecology and Management, Vol 284 (2012) 260–268.	This paper quantified how salvage logging influenced tree regeneration and fuel loads relative to nearby, uncut stands. Harvesting increased woody surface fuels more than 3-fold compared to untreated stands immediately after treatments; however, coarse fuels will increase substantially in untreated stands within three decades of the beetle infestation as dead trees topple, and the elevated fuel loads will persist for more than a century. Though salvage logging will treat a small fraction of beetle-infested Colorado forests, in those areas treatment will affect stand development and fuel loads and will alter potential fire behavior for more than a century.
Recovery of small pile burn scars in conifer forests of the Colorado Front Range; Rhoades, Charles; Paula Fornwalt, Mark Paschke, Amber Shanklin, Jayne Jonas; Forest Ecology and Management Vol 347 (2015) 180-187	The ecological consequences of slash pile burning are a concern for land managers charged with maintaining forest soil productivity and native plant diversity. Findings indicate that rehabilitation may not be required for small burn pile scars except in sensitive areas, such as those with water quality and invasive plant concerns.

RESEARCH PAPER, AUTHORS, PUBLICATION	Findings Summary
Slash Pile Burning Effects on Soil Biotic and Chemical Properties and Plant Establishment: Recommendations for Amelioration; Korb, Julie E., Nancy C. Johnson, W.W. Covington; Restoration Ecology, Vol 12, Issue 1 (2004)	This study investigated the effects of slash pile burning on soil biotic and chemical variables and early herbaceous succession on burned slash pile areas. These results indicate that seed/soil amendments that increase native forbs and grasses may enhance the rate of succession in burned slash pile areas by allowing these species to outcompete exotic and ruderal species also establishing at the site through natural regeneration.
Sediment concentration and turbidity changes during culvert removals; Foltz, RB, KA Yanosek, TM Brown; Journal of Environmental Management, Vol 87 (2008) 329–340	The concentrations of sediment and turbidity in stream water were monitored during culvert removals to determine the short term effects of road obliteration.
Reestablishing Groundwater and Surface Water Connections in Stream Restoration; Parola, Arthur A. and Hansen, Chandra; Sustain Magazine, Issue 24, Spring / Summer (2011)	This study investigated whether river restoration was successful in re-establishing groundwater–surface water interactions in a degraded urban stream. Results indicated that river restoration at the study site was indeed successful in increasing groundwater–surface water interactions.
The Stream Institute, University of Louisville's Stream and Wetland Restoration Program; Parola, Arthur C. and Biebighauser, Thomas R; Sustain Magazine, Issue 24, Spring / Summer (2011)	An article published in Sustain Magazine highlighting the U of Louisville's Stream and Wetland Restoration program.
Lost linkages and lotic ecology: rediscovering small streams; Meyer, J.L. and J.B. Wallace; The 41st Symposium of the British Ecological Society, 10-13 April (2000)	Paper examined the concepts that have shaped ecological research in flowing waters over the past quarter century and the opportunities for future advances in the field. Linking ecological, ethical, economic and legal analyses will be essential to sustain the integrity of lotic ecosystems (Meyer 1997).
Ridge Top to Valley Bottom: Restoring Whole Watersheds; USDA Forest Service; Forest Service, Pacific Northwest Region R6-NR-WFW-05-05; Portland, OR., July (2005)	A profile of completed watershed restoration efforts from the Pacific Northwest Region of the Forest Service. Projects highlighted in this report represent a variety of approaches with an array of treatment combinations—ranging from road removal to stream channel reconstruction to prescribed fires—all with a common end goal of ecosystem restoration.
Restoration in Action: The First Five Years of the Legacy Roads and Trails Program; Wildlands CPR; The Wilderness Society, April (2013)	This report highlights Legacy Roads and Trails accomplishments during its first five years. It provides a general accounting of appropriated funds and spotlights a sampling of projects from across the country. Legacy Roads and Trails was created specifically to provide crucial resources to fix and stormproof the roads we need, and to reclaim unneeded roads causing the most damage.

Appendix D – Sample Monitoring of Restoration Activities

Monitoring Document	Preparers	Source	Summary
Colorado Front Range Collaborative Forest Landscape Restoration Project: Ecological Monitoring of Treatment Effects on Stand Structure and Fuels through 2013	Rob Addington, Kristen Pelz, and Tony Cheng	Prepared by the Colorado Forest Restoration Institute at Colorado State University: Front Range Roundtable, November 2014	This report highlights accomplishments and ecological monitoring results for Front Range forest restoration treatments carried out under the Collaborative Forest Landscape Restoration Program through 2013.
Selway-Middle Fork, Collaborative Forest Landscape Restoration Program: 5 year report 2010-2014	Clearwater Basin Collaborative and US Forest Service	Selway-Middle Fork, Collaborative Forest Landscape Restoration Program	This 5-year report highlights progress to reduce fuels, improve watersheds and restore forest health on the Nez Perce-Clearwater NFs.
National Best Management Practices for Water Quality Management on National Forest Service Lands: Volume 1, National Core BMP Technical Guide	USDA Forest Service	USDA Forest Service, Forest Service-990a, April 2012	This technical guide provides information for implementing the National Core BMP portion of the Forest Service National BMP Program. The National Core BMPs were compiled from Forest Service manuals, handbooks, contract and permit provisions, and policy statements, as well as State or other organizations' BMP documents.

Appendix E – Summary of Extraordinary Circumstances by Agency

Agency	Extraordinary Circumstances	Description (from rule/regulation)	Citation
FS	T&E species	Federally listed threatened or endangered species or designated critical habitat, species proposed for Federal listing or proposed critical habitat, or Forest Service sensitive species	FSH 1909.15 Chapter 31.2
	Flood plains, wetlands, or municipal watersheds	Flood plains, wetlands, or municipal watersheds	
	Congressionally designated areas	Congressionally designated areas, such as wilderness, wilderness study areas, or national recreation areas	
	Inventoried roadless/ potential wilderness areas	Inventoried roadless areas or potential wilderness areas	
	Research natural areas	Research natural areas	
	American Indians and Alaska Native religious or cultural sites	American Indians and Alaska Native religious or cultural sites	
	Archaeological sites, or historic properties or areas	Archaeological sites, or historic properties or areas	
NRCS	Public health or safety	The proposed action cannot cause significant effects on public health or safety.	7 CFR 650.6
	Significantly affect unique characteristics	The proposed action cannot significantly affect unique characteristics of the geographic area, such as proximity to historic properties or cultural resources, park lands, prime farmlands, floodplains, wetlands, wild and scenic rivers, or ecologically critical areas.	
	Highly controversial	The effects of the proposed action on the quality of the human environment cannot be highly controversial.	
	Highly uncertain effects	The proposed action cannot have highly uncertain effects, including potential unique or unknown risks on the human environment.	
	Establish a new precedent	The proposed action cannot include activities or conservation practices that establish a potential precedent for future actions with significant impacts.	

Agency	Extraordinary Circumstances	Description (from rule/regulation)	Citation
	Potentially significant environmental impacts to quality of human environment	The proposed action is known to have or reasonably cannot be expected to have potentially significant environmental impacts to the quality of the human environment either individually or cumulatively over time.	
	Invasive species, T&E species, environmental justice, wetlands, wild and scenic rivers, air quality, migratory birds, bald and golden eagles	The proposed action cannot cause or promote the introduction of invasive species or have a significant adverse effect on any of the following special environmental concerns not previously identified in this section, such as: endangered and threatened species, environmental justice communities as defined in Executive Order 12898, wetlands, other waters of the United States, wild and scenic rivers, air quality, migratory birds, and bald and golden eagles.	
	Violates environmental protection laws	The proposed action will not violate Federal or other applicable law and requirements for the protection of the environment.	
DOI – BLM, BIA, BOR, NPS, FWS	Public health or safety	Have significant impacts on public health or safety.	43 CFR 46.215/516 DM 2, Appendix 2
	Significant impacts on natural resources and unique geographic characteristics	Have significant impacts on such natural resources and unique geographic characteristics as historic or cultural resources; park, recreation or refuge lands; wilderness areas; wild or scenic rivers; national natural landmarks; sole or principal drinking water aquifers; prime farmlands; wetlands (Executive Order 11990); floodplains (Executive Order 11988); national monuments; migratory birds; and other ecologically significant or critical areas.	
	Highly controversial environmental effects	Have highly controversial environmental effects or involve unresolved conflicts concerning alternative uses of available resources [NEPA section 102(2)(E)].	
	Highly uncertain and potentially significant environmental effects	Have highly uncertain and potentially significant environmental effects or involve unique or unknown environmental risks.	
	Establish a precedent for future actions	Establish a precedent for future action or represent a decision in principle about future actions with potentially significant environmental effects.	
	Cumulatively significant effects	Have a direct relationship to other actions with individually insignificant but cumulatively significant environmental effects	
	National Register of Historic Places	Have significant impacts on properties listed, or eligible for listing, on the National Register of Historic Places as determined by either the bureau or office.	

Agency	Extraordinary Circumstances	Description (from rule/regulation)	Citation
	T&E species and habitat	Have significant impacts on species listed, or proposed to be listed, on the List of Endangered or Threatened Species, or have significant impacts on designated Critical Habitat for these species.	
	Violates environmental protection law	Violate a Federal law, or a State, local, or tribal law or requirement imposed for the protection of the environment.	
	High/adverse effect on low income or minority populations	Have a disproportionately high and adverse effect on low income or minority populations (Executive Order 12898)	
	Limit access to and ceremonial use of Indian sacred sites	Limit access to and ceremonial use of Indian sacred sites on Federal lands by Indian religious practitioners or significantly adversely affect the physical integrity of such sacred sites (Executive Order 13007).	
	Invasive species	Contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area or actions that may promote the introduction, growth, or expansion of the range of such species (Federal Noxious Weed Control Act and Executive Order 13112).	