United States Department of Agriculture

Santa Fe Mountains Landscape Resiliency Project

Environmental Assessment

for:

Española and Pecos-Las Vegas Ranger Districts
Santa Fe National Forest

Forest Service | Santa Fe National Forest | Española and Pecos-Las Vegas Ranger Districts | December 2022

Responsible Official:

James Duran, Acting Forest Supervisor
Santa Fe National Forest

For more information contact:

Sandra Imler-Jacquez, District Ranger
Española Ranger District
18537 U.S. Highway 84/285, Suite B
Española, New Mexico 87532
505-753-7331
sandra.imler-jacquez@usda.gov

Cover Photo. Visualization of the Proposed Action from an observation point from the summit of Monte Sol.
Photo credit to David Fothergill, Enterprise Program Landscape Architect

Contents

List of Figures

List of Tables

ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
AUM	Animal Unit Months
AMSL	Above Mean Sea Level
BA	basal area
BE	biological evaluation
BLM	Bureau of Land Management
CCVA	Climate Change Vulnerability Assessment
CFR	Code of Federal Regulations
CH	Critical Habitat
CH_4	methane
CO	carbon monoxide
Coalition	Greater Santa Fe Fireshed Coalition
CP	criteria pollutant
CSE	Common Stand Exam
CWPP	community wildfire protection plan
dbh	diameter at breast height
DOC	dissolved organic carbon
drc	diameter at root collar
E	East
EA	environmental assessment
EIS	environmental impact statement
EMU	ecological management unit
EPA	U.S. Environmental Protection Agency
ERU	ecological response unit
ESA	Endangered Species Act
FIA	Forest Inventory Analysis
Fireshed	Greater Santa Fe Fireshed
FOFEM	First Order Fire Effects Model
the Forest	Santa Fe National Forest
Forest Plan	Santa Fe National Forest Land Management Plan
FR	*Federal Register*
FVS	Forest Vegetation Simulator
GHG	greenhouse gas
GIS	geographic information system

HUC	hydrologic unit code
IDF	integrated design feature
IDT	Interdisciplinary Team
IFTDSS	Interagency Fuel Treatment Decision Support System
IMPROVE	Interagency Monitoring of Protected Visual Environments
IPaC	Information for Planning and Consultation
IRA	inventoried roadless area
MBTA	Migratory Bird Treaty Act
MIS	Management Indicator Species
MSO	Mexican spotted owl
N	North
NEPA	National Environmental Policy Act
NFS	National Forest System
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NOx	nitrogen oxides
NWCG	National Wildfire Coordinating Group
PA	programmatic agreement
PAC	protected activity center
PCE	primary constituent element
PFA	post-fledging area
PM	particulate matter
PM_{10}	particulate matter 10 microns in diameter or smaller
$PM_{2.5}$	particulate matter 2.5 microns in diameter or smaller
project	Santa Fe Mountains Landscape Resiliency Project
R	Range
R&PP	Recreation and Public Purpose Act
RAWS	Remote Automated Weather Stations
RDI	relative density index
RMAP	Regional Riparian Mapping Project
ROS	Recreation Opportunity Spectrum
SCC	Species of Conservation Concern
SFMLRP	Santa Fe Mountains Landscape Resiliency Project
SFNF	Santa Fe National Forest
SH	State Highway
SHPO	State Historic Preservation Office

SIO	scenic integrity objective
SOPA	Schedule of Proposed Action
SRM EMU	Southern Rocky Mountains ecological management unit
SUP	special use permit
SWCA	SWCA Environmental Consultants
T	Township
TCP	Traditional Cultural Property
Tg	teragram
TMDL	total maximum daily load
TPA	trees per acre
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTV	utility terrain vehicle
VCC	Vegetation Condition Class
VDDT	Vegetation Dynamics Development Tool
VOC	volatile organic compound
VRAs	valued resources and assets
VSS	vegetation structural stage
WEPP	Watershed Erosion Prediction Project
WUI	wildland urban interface

Chapter 1. Purpose and Need

1.1 Introduction

The Santa Fe Mountains Landscape Resiliency Project (SFMLRP or project) is a restoration project spanning approximately 38,680 acres of the 50,566-acre planning area proposed by the U.S. Forest Service Española and Pecos-Las Vegas Ranger Districts. The purpose of the project is to improve the ecosystem resilience of a priority landscape to future disturbances including wildfire, climate change, and insect outbreaks. To meet this purpose, the U.S. Forest Service proposes mechanical and manual vegetation thinning treatments, use of prescribed fire, and riparian restoration on National Forest System (NFS) lands within the project area. The project also includes road closure of up to 1.5 miles of NFS roads. Initial forest thinning treatments would be conducted over the next 10 years (ranging from 5 to 25 years), and maintenance burning would occur approximately every 5 to 10 years.

Disturbances such as fire are a natural ecosystem process. However, human influences on the landscape over the past century, such as wildfire suppression, have changed forest composition, structure, and consequently changed the intensity and magnitude of impacts resulting from wildfire disturbance. A substantial amount of fire research exists that documents the shift in vegetation as a result from the elimination of fire as natural ecosystem process has resulted in historic low-intensity, surface fire regimes to stand-replacing, crown fire regimes on southwestern forests (Allen et al. 2002; Cooper 1961; Covington et al. 1997; Covington and Moore 1994; Margolis and Balmat 2009; Moore et al. 2004; Romme et al. 2009; Swetnam and Baisan 1996). Prescribed fire and vegetation thinning treatments are needed to improve the resiliency of forest conditions and reestablish historic low-intensity fire disturbance on forested landscapes.

The project is located within the Greater Santa Fe Fireshed (Fireshed), which is a 107,000-acre landscape, along the Santa Fe Mountains near Santa Fe, New Mexico, in the southern Sangre de Cristo Mountain Range. Forest, fire, and water managers agree that after more than a century of fire suppression, there has been a transition in vegetation on this landscape which puts it at a great risk of large, high-severity wildfire and post-fire flooding and debris flow (Bassett 2018). The Fireshed is an area of concern for the City of Santa Fe, Santa Fe County, the Pueblo of Tesuque, the SFNF, communities within and adjacent to its boundary, those who recreate and enjoy this landscape, and the tourism and ecotourism economies that benefit from its use. In December 2015, the New Mexico State Forester and the City of Santa Fe Fire Chief convened a meeting of municipal, county, state, federal, and non-profit partners to discuss this priority landscape, which led to the formation of a collaborative group called the Greater Santa Fe Fireshed Coalition (Coalition).

The stated mission of the Coalition is to:

"…use a pro-active, collaborative approach to improve the health and long-term resilience of forested watersheds and communities by addressing wildfire…Our primary goal is to identify and implement high priority on-the ground projects that make the Fireshed and its communities more resilient to wildfire while maintaining and restoring resilient landscapes. This goal will be realized when fire is used as a tool for management throughout our fire adapted forests, and communities in and adjacent to these forests become fire adapted - they understand the role of fire and are prepared for its occurrence."
(Greater Santa Fe Fireshed Coalition 2020)

The Coalition comprises organizations and individuals who are working to improve the ecological condition of the Fireshed area through a combination of outreach and vegetation management activities. Since 2015, the Coalition has met quarterly to coordinate and prioritize restoration work and to jointly conduct public outreach in the Fireshed area. With NFS lands, which comprise approximately 65,000 acres of the 107,000-acre Fireshed area, there is a need for the U.S. Forest Service to conduct forest resiliency treatments at a landscape scale to improve the ecosystem resilience, which complements the Coalition's aforementioned mission.

1.1.1 Project Location

The project covers 50,566 acres on the Española and Pecos-Las Vegas Ranger Districts of the SFNF (Figure 1.1. Project vicinity map). The project is located within and adjacent to the larger 107,000-acre Fireshed described above. The project boundary does not include all NFS lands in the Fireshed. U.S. Forest Service lands not included in the project area include the majority of the Santa Fe Municipal Watershed, the La Cueva Fuelbreak Project in lower La Cueva, the Hyde Park Wildland Urban Interface Project, and the Pacheco Canyon Forest Resiliency Project, because these areas have previous NEPA decisions associated with them. The project boundary does not perfectly align with the Fireshed boundary, particularly in the southeast corner of the project area. In this area, the project boundary extends outside of the Fireshed boundary to include high-priority treatment areas in the Pecos-Las Vegas Ranger District.

The legal description of the project area is:

- Township (T) 16 North (N), Range (R) 10 East (E), Sections 1–4, 10–15, 23–25
- T16N, R11E, Sections 1–21, 24, 25, 29–31
- T16N, R12E, Sections 6, 7, 18, 19
- T17N, R10E, Sections 1–5, 20, 21, 24–29, 32–36
- T17N, R11E, Sections 6–8, 17–20, 25–27, 29–36
- T17N, R12E, Sections 30, 31
- T18N, R10E, Sections 1–4, 9–13, 15, 16, 19–36
- T18N, R11E, Sections 5–10, 16–21, 28–32
- T19S, R10E, Section 34

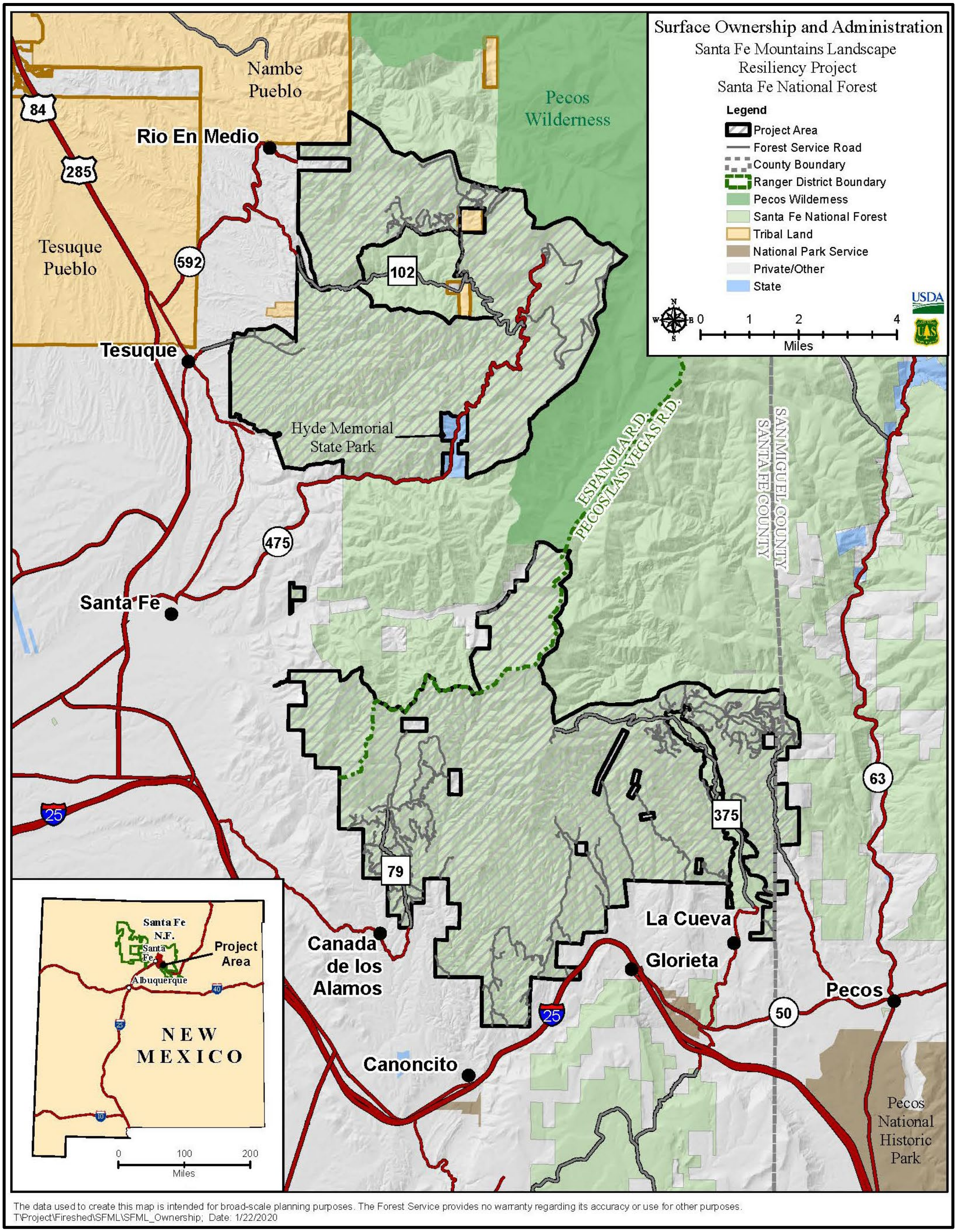


Figure 1.1. Project vicinity map.

1.2 Purpose and Need

The purpose of the SFMLRP is to improve the ecosystem resilience of a priority landscape to future disturbances by restoring forest structure and composition and reducing the risk of catastrophic wildfire. Resilience is the "ability of a social or ecological system to absorb disturbance while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change" (U.S. Forest Service Manual 2020.5). A critical component of improving resilience in the project area is creating conditions that facilitate the reintroduction of fire, a keystone ecological process, in the frequent-fire vegetation types found across this landscape (Margolis and Balmat 2009). This translates to managing forest structure, composition, and densities that would not contribute to active crown fire. Moreover, under desired conditions, prescribed burns and natural ignitions under most circumstances would remain at low to moderate intensities.

Fire has historically played an important ecological role by frequently burning at regular intervals (approximately 5–15 years) at low to moderate intensities in the ponderosa pine and mixed conifer frequent fire forests of the project area (Bassett 2018). There is abundant evidence of the fire history in these types of forests from tree-ring data that have been collected within the Sangre de Cristo Mountains and within the project area (Margolis et al. 2007; Margolis and Balmat 2009). However, a combination of fire suppression, firewood gathering, and grazing that began in the late 1800s has contributed to departure from the natural vegetative conditions, disturbance regimes and desired conditions (Bassett 2018). As a consequence of over a century without natural fire patterns, these forests have become overly dense, less diverse in structure and spatial pattern, and have experienced shifts in species composition toward shade-tolerant species (for example, Douglas-fir [*Pseudotsuga menziesii*] and white fir [*Abies concolor*]) that are less fire-adapted. The presence of shade-tolerant tree species has increased significantly in these forests due to fire suppression, and in turn has resulted in increased ladder fuels and fire hazard while crowding out more characteristic tree species, such as ponderosa pine (*Pinus ponderosa*), southwestern white pine (*Pinus strobiformis*), and quaking aspen (*Populus tremuloides*). In addition to altering forest structure, spatial pattern, and composition, fire exclusion has also led to higher fuel loads.

These changes negatively impact ecosystem function and make the forests and watersheds of the project area less resilient to natural disturbances. For example, high tree density is associated with greater susceptibility to insect outbreaks, poor tree growth and vigor, and lower understory plant production (Allen et al. 2002; Fettig et al. 2007;). With a changing climate, the frequency, intensity, and extent of disturbances are expected to worsen. Treatment of forest conditions to move towards desired conditions described in the 2022 Santa Fe National Forest Land Management Plan (Forest Plan) would improve these forests' resilience to disturbances and improve ecosystem function.

In Mexican spotted owl (MSO) (*Strix occidentalis lucida*) habitat, there is a need to protect existing habitat and promote development of future habitat suitable for nesting, roosting, foraging, and dispersal to further recovery of the species.

To increase the resilience of the forests and watersheds in the project area, there is a need to:

- move the frequent-fire forest ERU vegetation types in the project area toward their characteristic species composition, structure, and spatial patterns in order to improve ecological function;
- create conditions that facilitate the safe reintroduction of fire, allowing fire to play its natural role in frequent fire forest types;
- reduce the risk for large high-intensity wildfires and create safe, defensible zones for firefighters and minimize the risk of fire to nearby valued resources;

- improve and maintain diverse wildlife habitats to provide a large array of habitat types, habitat components, seral states, and corridors for a variety of species that utilize the area; and
- improve watershed conditions by restoring the vegetation structure and composition of riparian ecosystems and by maintaining and improving water quality.

1.3 Framework for Improving Ecosystem Resilience

Ecological restoration is an outcome of managing for desired conditions. Restoration is an intentional activity that initiates or accelerates ecosystem recovery with respect to its health (functional processes, productivity), integrity (species composition, community structure), and sustainability (resistance and resilience to disturbance). In frequent fire forests of the western United States, fire historically represented the negative feedback mechanism that maintained ecosystem resilience, with characteristic of large, old, and fire-resistant trees and open understory (Covington and Moore 1994; Hessburg et al. 2005; Larson et al. 2013). These frequent-fire forests have become subject to declining resilience and consequently increased vulnerability to catastrophic wildfire (Wu and Yeon-Su 2013). The objective of ecological restoration in the context of the project is to reestablish and retain ecological resilience of NFS lands. Restoration of frequent-fire forests focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to make terrestrial and aquatic ecosystems sustainable, resilient, and productive under current and future conditions. Restoration may not necessarily return an ecosystem to its former state, because contemporary constraints and conditions can cause it to develop along an altered trajectory (Clewell et al. 2005; Pilliod et al. 2006).

Forest ecology, historical conditions (Kaufmann et al. 1998), and the historic range of variability are frequently used to define the goals for forest ecosystem treatments, to estimate the restoration potential of sites, and to evaluate the success of forest ecosystem treatments, together referred to as the framework for improving ecosystem resilience. Reference conditions, often characterized by historic range of variability, provide a scientific basis for understanding forests, and a framework for understanding forest conditions and ecological processes prior to extensive human influence. Reference conditions provide a best estimate of a functional and sustainable system and are a useful basis for developing desired conditions while accounting for uncertainties (e.g., climate change). That is, restoration looks to ecological history as a means of identifying appropriate desired conditions. Desired conditions use historical ecology within the context of historic range of variability in each vegetation type, in addition to social and economic considerations, as a template for management action. Action is focused on bringing the ecosystem to the desired condition by restoring composition, structure, and function on the same or similar trajectory. In many cases the reintroduction of fire can do much of the work of ecological restoration, by recreating the natural interaction of structure and process (Allen et al. 2002). The range of natural variability differs across sites, both within and among vegetation types, because landscapes vary widely in soils, elevation, aspect, species composition, structure, and pattern. Historical evidence (old trees, large snags and logs, old stumps) on sites are used to develop desired conditions and guide prescriptions at the site level (Moore et al. 1999; Friederici 2003).

As identified by Reynolds et al. (2013) and Margolis et al. (2013), these key compositional and structural elements that characterized Southwest forests before industrial logging and the disruption of historical disturbance regimes are:

- species composition (tree and understory vegetation);
- groups of trees;
- scattered individual trees;
- open grass-forb-shrub interspaces between tree groups and individual trees;

- snags, logs, and woody debris; and
- variation in the arrangements of these elements in space and time.

The plant species compositions and physical structure of ecological response units (ERUs) change over time following major disturbances such as wildfire or other significant tree die-off. Plant community succession (also called ecological succession) and descriptions of seral states are used to characterize the ERUs over time, relative to vegetation recovery from environmental disturbance (see Dick-Peddie 1993). Plant succession is the change in dominant plant species composition over time following a disturbance that removes most of the existing plants from a given landscape area. Each sequential change in plant community composition is called a seral state, and each seral state also changes the environment of the plant community (e.g., more shade, more soil cover, taller plants, different nutrient availability, etc.) (Figure 1.2).

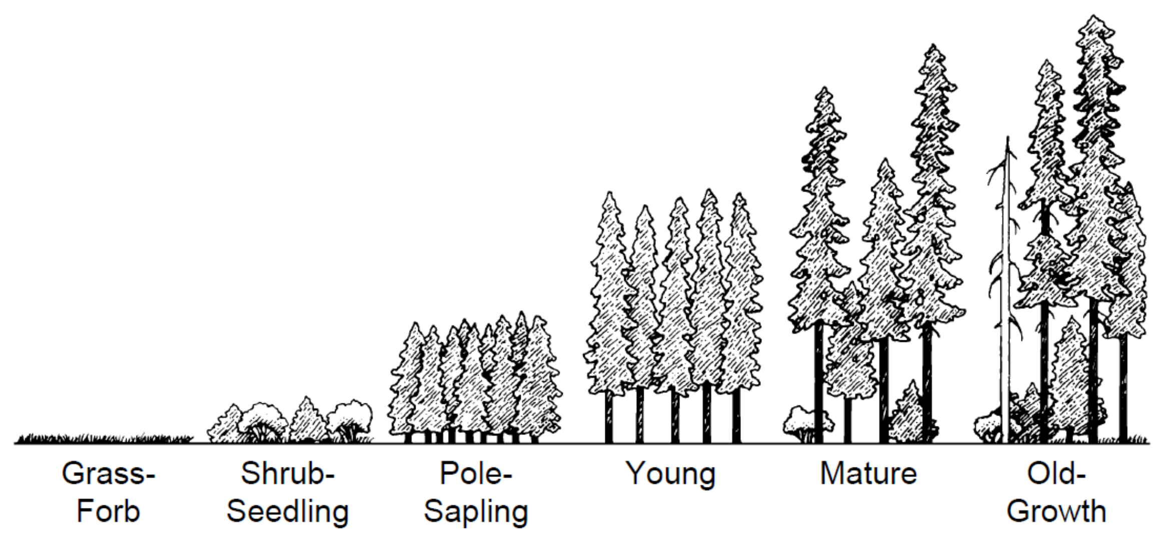


Figure 1.2. Example of successional stages for forest ecosystems (adapted from Thomas et al. 1979). Source: Powell 2012.

The intent of the framework for improving ecological resilience is to inform management strategies that will shift these forest ecosystems toward reference conditions. Managing for the framework's key elements should increase the resilience of the forests and facilitate opportunities for the resumption of characteristic function and disturbance regimes. Expected outcomes include increased biodiversity, plant and animal habitats, and ecosystem services; increased resilience to insects, disease, and climate change; and reduced fuel loads and fire hazards.

Desired conditions within the project area are characterized at three spatial scales:

- Landscape scale (1,000 to 10,000 or more acres)
- Mid-scale (10 to 1,000 acres)
- Fine scale (less than 10 acres)

The landscape scale provides the "big picture" of the desired conditions across the larger land area. The landscape scale is composed of aggregates of mid-scale units and usually has variable elevations, slopes, aspects, soil types, plant associations, disturbance processes, and land uses. The proposed project is a landscape-scale project, and development of the Proposed Action (provided in Chapter 2) has been informed by analyzing available data and modeling at the landscape scale.

Mid- and fine scales provide additional details necessary for guiding site-specific projects and activities. These scales generally correspond to forest structural features. The fine scale is an area in which the species composition—age, structure, and spatial distribution of trees (single and grouped)—and grass-forb-shrub interspaces are expressed. Aggregates (groups or clusters) of fine-scale units comprise mid-scale patches or stands, which are relatively homogeneous in vegetation composition and structure. Implementation of the proposed project would happen at the mid- and fine scales. Figure 1.3 illustrates the three spatial scales used to describe desired conditions for each vegetation type (Reynolds et al. 2013).

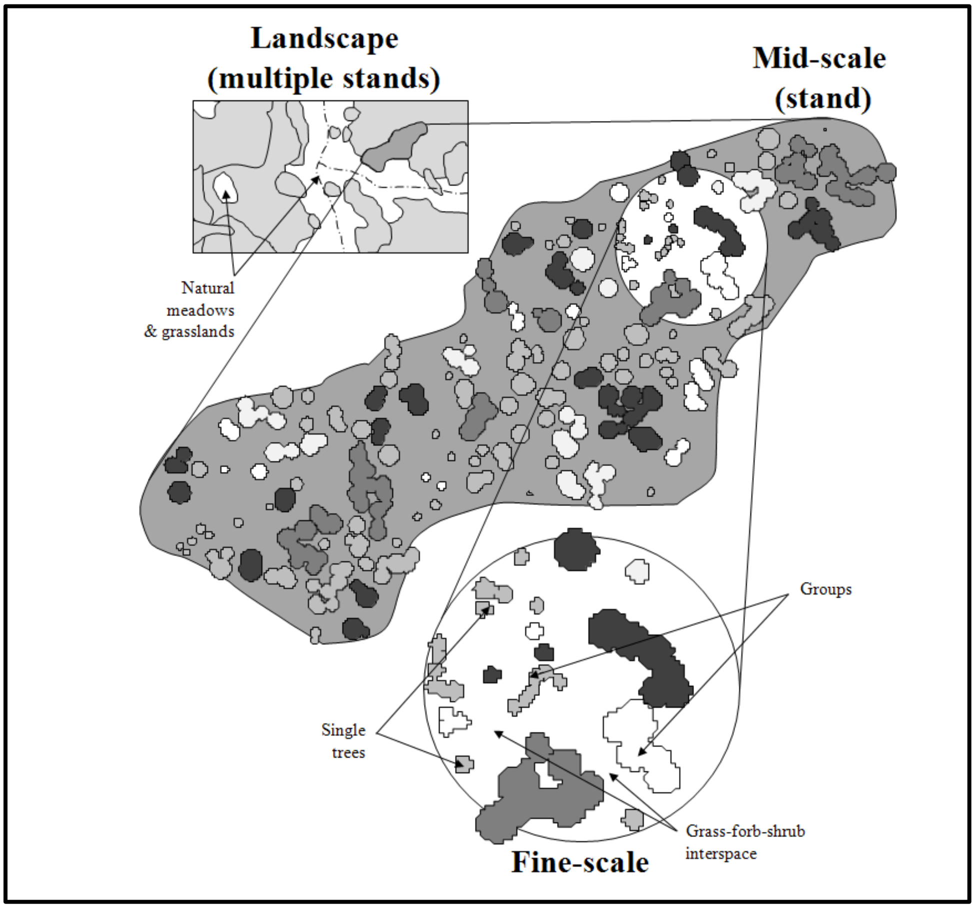


Figure 1.3. Illustration of the three spatial scales (source: Reynolds et al. 2013).

The framework for improving ecosystem resilience relies on desired condition objectives defined for ERUs, which are generally described as vegetative communities. These units represent an ecosystem stratification based on vegetation characteristics that would occur when natural disturbance regimes and biological processes prevail and combine potential vegetation and historical fire regimes to form ecosystem classes useful for landscape assessment (U.S. Forest Service 2014, 2015a). Table 1.1 and Figure 1.4 present the primary ERUs that occur in the project area. All lands within the project area are NFS lands.

Table 1.1. ERUs and Their Approximate Acreage in the Project Area

ERU*	Approximate Acres in Project Area	Approximate Acres in Santa Fe National Forest†
Mixed Conifer–Frequent Fire Forest	**17,875**	**429,967**
Ponderosa Pine Forest	**17,347**	**403,915**
Pinyon-Juniper Woodland, Pinyon-Juniper Grassland, and Juniper Grasslands	**8,660**	**274,864**
Spruce-Fir Forest	5,022	250,481
Montane/Subalpine Grassland	491	17,707
Mixed Conifer with Aspen	456	40,174
Riparian: primarily Narrowleaf Cottonwood/ Shrub	503	45,993
Colorado Plateau/Great Basin Grassland	139	41,639
Alpine and Tundra	63	5,015
Total	**50,556**	

* Bolded text indicates those ERUs proposed for treatment, as described in Chapter 2.

† Source: U.S. Forest Service (2022a).

Not all ERUs listed in Table 1.1 or Figure 1.4 are in need of treatment to move towards desired conditions. As discussed in detail in Chapter 2, the following ERUs are proposed for forest resiliency treatments: mixed-conifer-frequent fire forest, ponderosa pine forest, pinyon-juniper woodland, pinyon-juniper grasslands, and juniper grasslands. Specific treatment objectives for each ERU proposed for treatment within the project area are described in detail in Section 1.4.4, Ecological Response Units. Desired conditions for forest structure, fire hazard reduction in the wildland–urban interface, watershed health, and MSO habitat protection and development objectives are also addressed below.

The types, frequencies, and severities of disturbances (e.g., fires, insects, and diseases) played an important role in shaping the historical composition, structure, and function of Southwest forests. Each ERU in the project area has a natural fire regime that is integral to its ecological functions and processes. Mixed conifer frequent fire and ponderosa pine communities historically exhibited lower stand densities, reduced canopy cover, and low surface fuel loading and supported low- to mixed-severity wildfire, with short fire return intervals (Covington and Moore 1994). Mesic mixed conifer communities and pinyon-juniper ecosystems exhibit longer fire return intervals and therefore high-intensity, stand-replacing wildfire may not be abnormal in these forest types (Margolis et al. 2011; Singleton et al. 2019). However, the current forest structure and juxtaposition with the wildland urban interface (WUI) setting, complicates tolerance of high-intensity wildfire. Where forest composition and its structure allow, the framework recommends that fire, the primary historical disturbance agent in these forests, play a prominent role in their restoration. The framework also emphasizes that mechanical treatments may be necessary to initiate suitable compositions and structures before reintroducing fire. Conversely, fire may be the only suitable tool for some areas. Restoration provides opportunities for the reestablishment of the characteristic disturbance regimes as well as the spatial and temporal links between pattern and process (e.g., the feedback relationship between forest structure and fire) that sustained the characteristic composition and structure of these forests. Implementation of this framework should improve overall ecosystem productivity and function and enhance ecosystem services such as soil productivity, biodiversity, wildlife habitat, clean air, water quality and quantity, wood products, and recreation. More information about the Proposed Action, which would be used to implement the restoration framework within the project area, is provided in Chapter 2.

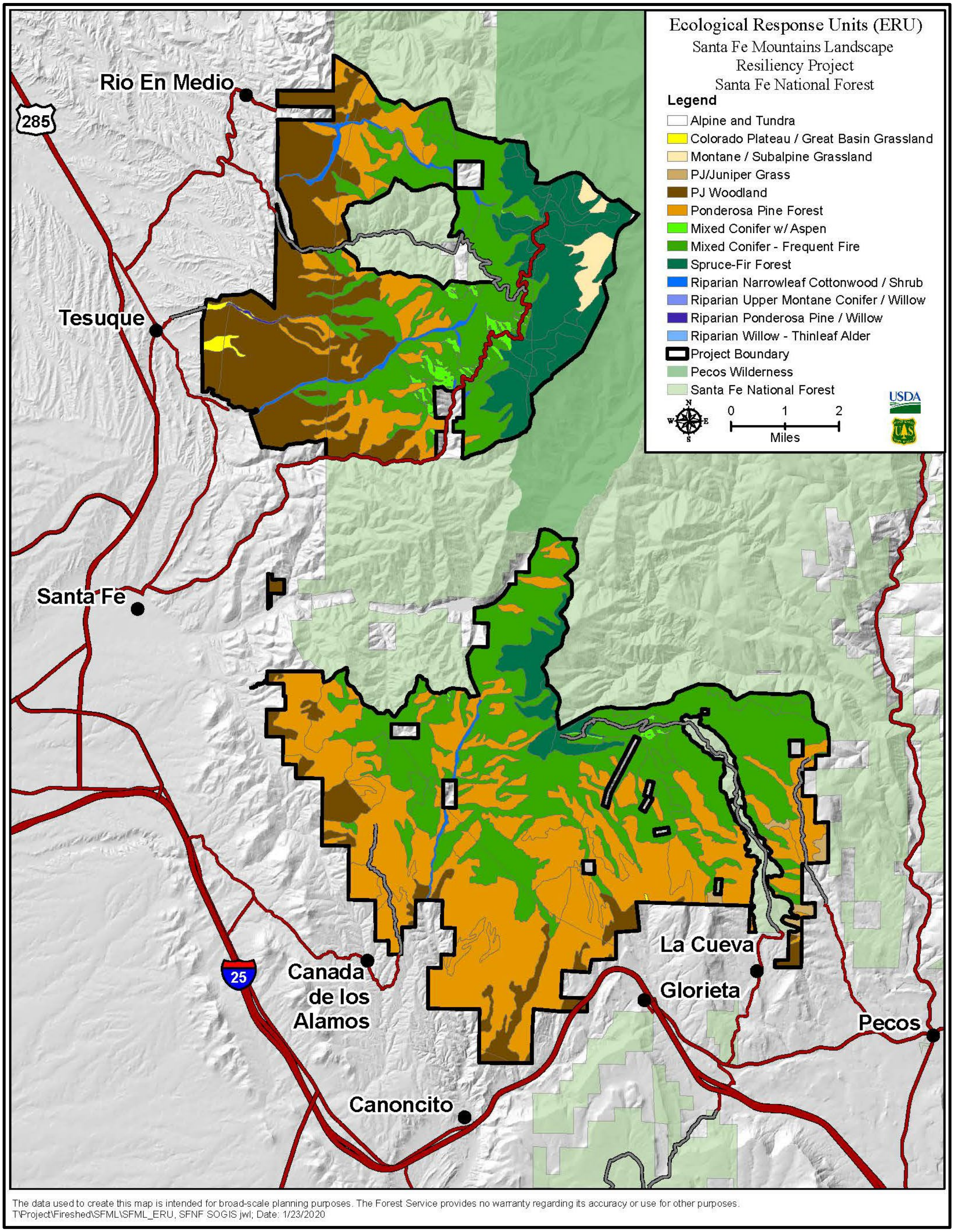


Figure 1.4. ERUs within the project area.

1.4 Existing and Desired Conditions

Desired conditions are generally described as how vegetative communities should look and function when restored. Local ecological conditions vary across the Santa Fe National Forest and there may be a need to make adjustments to account for unique situations. Desired conditions reflect the characteristics necessary to restore and sustain ecosystems, including structure, composition, landscape patterns, and processes, and to provide for the habitats of native wildlife species and MSO. They also provide for the development of old-growth characteristics. Ecological restoration is an outcome of managing for desired conditions.

1.4.1 Fire Regimes and Hazards

Existing Conditions

The resilience of downstream communities to wildfire is a concern across the project area. The existing fuel conditions found across much of this landscape contribute to a heightened risk for large patches of high-intensity fire. The presence of ladder fuels and high canopy cover levels found across much of the project area would also contribute to intense fire behavior by increasing the potential for torching and active crown fire. Large, high-intensity wildfire would threaten the many ecosystem services provided by the forests of the project area, such as wildlife habitat, clean air, agriculture, recreation, and drinking water production, and would also have devastating post-fire effects, such as floods, to downstream communities (U.S. Forest Service 2021a). Furthermore, the continuity of fuels across the project area in combination with the steep topography limit the options for defensible zones where firefighters have the potential to safely engage with a wildfire.

A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention (but including the possible influence of aboriginal fire use). The five natural fire regime groups (described in Table 1.2 below) are classified based on the average number of years between fires (fire frequency) combined with characteristic fire severity (reflected by percent replacement of dominant overstory vegetation). Most of the project area is in fire regime groups I and III (Hann et al. 2008; LANDFIRE 2020). The vast majority of the SFMLRP area has not burned in over 100 years (Figure 1.5) (National Wildfire Coordinating Group [NWCG] 2020a; Margolis et al. 2020).

Table 1.2. Fire Regime Group Descriptions and ERU Acreages within the Project Area

Group	Frequency (years)	Severity	Severity Description	ERU	SFMLRP Acreage*
I	0 – 35	Low / mixed	Generally low-severity fires replacing less than 25% of the dominant overstory vegetation; can include mixed-severity fires that replace up to 75% of the overstory	Mixed conifer - frequent fire forest	17,875**
				Ponderosa pine forest	17,347**
				Pinyon-juniper grassland	1
				Juniper grassland	223
II	0 – 35	Replacement	High-severity fires replacing greater than 75% of the dominant overstory vegetation	Colorado Plateau / Great Basin grassland	140
				Montane / subalpine grassland	491
III	35 – 200	Mixed / low	Generally mixed-severity; can also include low-severity fires	Mixed conifer - frequent fire forest	17,875**
				Mixed conifer with aspen	456
				Pinyon-juniper sagebrush	0
				Pinyon-juniper woodland	8,436**

Group	Frequency (years)	Severity	Severity Description	ERU	SFMLRP Acreage*
IV	35 – 200	Replacement	High-severity fires	Mixed conifer with aspen	456
				Spruce-fir forest	5,022**
				Sagebrush shrubland	0
V	200+	Replacement / any severity	Generally, replacement-severity; can include any severity type in this frequency range	Spruce-fir forest	5,022**
				Pinyon-juniper sagebrush	0
				Pinyon-juniper woodland	8,436**

* For five ERUs, covering about 565 acres in the SFMLRP area, the U.S. Forest Service does not have fire regime information or desired condition direction. These ERUs are mostly riparian and are not within areas proposed for treatment in the SFMLRP, although prescribed fire may be allowed to burn into the ERUs. These ERUs are: Alpine and Tundra—10 acres; Regional Riparian Mapping Project (RMAP) Narrowleaf Cottonwood / Shrub—503 acres; RMAP Ponderosa Pine / Willow—31 acres; RMAP Upper Montane Conifer / Willow—15 acres; RMAP Willow - Thinleaf Alder—6 acres.
** Acreages representing ERUs share Fire Regime Groups, not total ERU acreage of each Fire Regime Group.

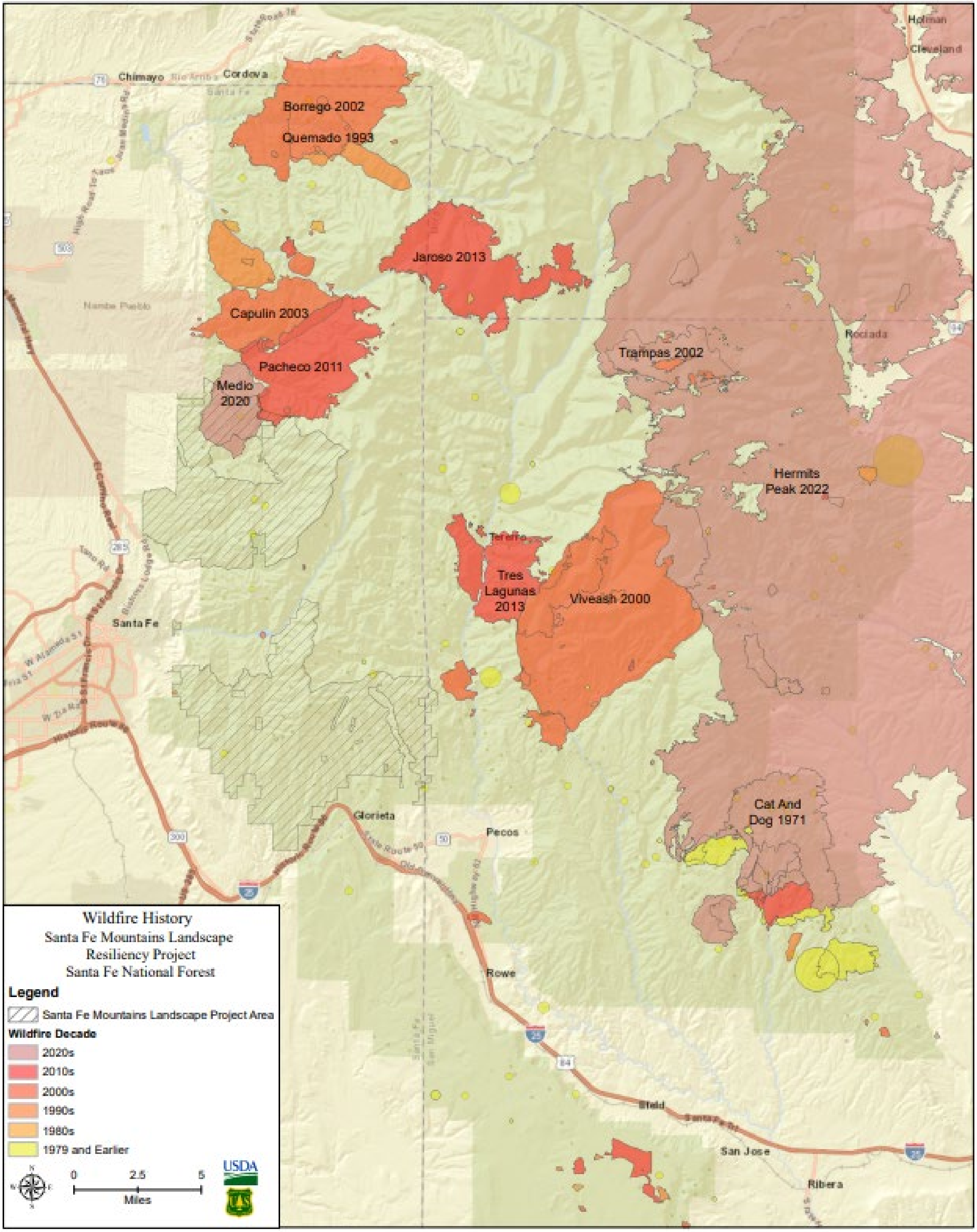


Figure 1.5. Fire history map of the SFMLRP area.

The majority (64%) of the fires that burned in the Santa Fe Watershed also burned in adjacent watersheds. The last synchronous fire was over 135 years ago (1886). The degree of reconstructed historical synchrony, combined with observations of modern fires commonly burning across watershed boundaries, suggests that fire spread between the Santa Fe Watershed and adjacent watersheds was likely common. Currently, the prevailing winds are generally from the south to the west during the fire season (May and June), which suggests that fires in adjacent watersheds have the high potential to spread into the Santa Fe Watershed, particularly the Upper Santa Fe Watershed. This indicates that a landscape-scale perspective to forest, fire, and watershed management is necessary.

The Proposed Action does not include treatment in spruce fir forest. However, treatments in adjacent ERUs are focused upon mitigating potential fire spread into the spruce fir ERU, for example spread into forested areas upslope of State Highway (SH) 475 (Hyde Park Road) where there is a high concentration of recreational areas (trails), infrastructure (Ski Santa Fe and acequias), and property that could be impacted by intense wildfire. There is a need to improve public safety around SH 475, as it would be an important evacuation route in the event of a high-intensity wildfire. Post-fire debris flow and erosion would also have the potential to cause significant damage to these resources.

The risk for wildfire is also a major concern along the lower elevations and southern portion of the project area due to the high surface fuel loads found in much of the pinyon-juniper woodlands. Historical fire regimes in pinyon-juniper vegetation types are highly variable and based primarily on the environmental context, vegetation composition, and structure (Floyd et al. 2004; Triepke et al. 2019). The pinyon-juniper woodlands in the project area typically exhibit more closed canopy structure, and a mix of grass and shrub understory. These communities have been described by Romme et al. (2009) as Persistent Woodland, and due to their structural composition, tend to have moderate surface to high-intensity canopy fires, that occur infrequently, but under extreme conditions can reach a landscape scale (Triepke et al. 2019).
The pinyon-juniper woodlands form the interface with many communities. The potential for high to extreme fire behavior in this fuel type increases wildfire hazard and risk to life and property. There is a need to reduce the continuity of surface fuels in these areas, particularly where they abut other land jurisdictions and valued resources.

In the wildland fire community, the term “hazard” is used to define a variety of conditions or situations where damage to assets by fire is evaluated. Approximately 31% of the SFMLRP area is at higher to highest hazard of burning. More information about fire hazard can be found in Section 3.3.

The project area is described in the 2020 Santa Fe County community wildfire protection plan (CWPP) as being at high risk for catastrophic wildfire (SWCA Environmental Consultants [SWCA] 2020). According to fire behavior modeling used to develop the CWPP’s Composite Risk Assessment, the project area is modeled to exhibit flame lengths over 11 feet, rapid rates of spread (from 20 to 30 feet/minute), and fireline intensity of over 1,000 British Thermal Units/minute (heat per unit area) (SWCA 2020). This fire behavior poses a greater resistance to control (a fire intensity that cannot be attacked directly by persons with hand tools [Andrews et al. 2011]) and therefore has a higher potential for large wildfire spread.

Existing forest structure conditions, in all forest types, can be described by:

- A general pattern of increasing length of intervals between low-intensity surface fires (Swetnam and Baisan 1996), resulting in a significant departure from the natural range of variability and predisposed to a high risk of loss of key ecosystem components (Hann and Bunnell 2001). According to similar studies across the region (Swetnam and Baisan 1996), the current fire-free interval (119 years) in the project area within frequent fire ERUs is over 11 times the historical maximum fire-free interval (U.S. Forest Service 2022a).

- Low crowning index (the wind speed in miles per hour necessary for a fire that reaches the forest canopy to continue as a crown fire) values, meaning a crown fire would remain active even at relatively low wind speeds, sustaining high-intensity, widespread, damaging fire over large portions of the project area.

Desired Conditions

The desired condition is for reduced fuel loads in areas where vegetative conditions would contribute to high-intensity crown fire, rapid rates of spread and high flame lengths, and where wildfire would cause damage to resources and values at risk (for example, residential properties, critical infrastructure, watershed, MSO habitat) and the WUI. Surface fuel loads should average between approximately 5 to 7 tons per acre in ponderosa pine forest, approximately 10 to 12 tons per acre in mixed conifer-frequent fire forest, and 3 to 12 tons per acre in pinyon juniper woodland. In areas characterized by continuous fuels in close proximity to valued resources, there is a need to provide defensible zones where firefighters can safely engage with wildfires. Fuels in this zone should be mitigated to the extent that crown fires would transition to surface fire activity, creating areas with lower flame lengths and fireline intensity, to lower resistance to control and allow direct attack by fire crews with hand tools. Where persistent pinyon-juniper woodland interfaces with communities (is in the Wildland Urban Interface), treatments should result in increased canopy base heights and greater canopy spacing to prevent transmission of active crown fire. Mitigating fuel loading and potential fire behavior in WUI areas helps to facilitate forest treatments, including the reintroduction of prescribed fire, in other adjacent ERUs. In ponderosa pine and mixed conifer-frequent fire forest types, meeting the desired conditions for restoration would also achieve desired conditions for wildfire risk reduction by reducing fuels and breaking fuel continuity in frequent-fire forest types.

1.4.2 Old Growth

Existing conditions

Old growth forests provide biological diversity and key wildlife habitat for a variety of species. Large and mature trees are found throughout the project area. However, the development of future large, mature trees is limited in areas characterized by dense stands of small to medium sized trees. Existing old growth is also at risk for damage or loss due to high-severity wildfire, insects, and disease.

The existing condition for all of the dominant forest types in the SFMLRP is deficient of late seral/large tree stages. This project does not propose to cut any trees over 16 inches in diameter in order to move the area toward the desired condition.

Desired Conditions

Desired conditions in the 2022 Santa Fe National Forest Land Management Plan stresses the importance of retaining old growth and for managing vegetation in ways that support its development over time. For the mixed conifer-frequent fire and ponderosa pine ERUs, old growth would occur throughout the landscape, generally in small areas as individual old-growth components, or as clumps of old growth. Old growth characteristics for these ERUs are embedded in the late seral stages of stand development. These characteristics would include old or large trees, dead trees (snags), downed wood (coarse woody debris), and structural diversity. The location of old growth would shift on the landscape over time as a result of succession and disturbance. The desired conditions for frequent-fire ERUs include a high proportion of mid to late seral states. Additionally, the desired condition for Forest-wide vegetation is a healthy and resilient forest ecosystem with a component of old, large trees or a component of trees that would develop toward old, large trees in the long term. More information about old growth can be found in Section 3.2

1.4.3 Watershed Conditions

Existing conditions

The project area includes portions of 10 subwatersheds (hydrologic unit code [HUC] 12 subwatersheds) with approximately 60 miles of perennial stream, 48 miles of intermittent channels, and nearly 650 miles of ephemeral streams. The U.S. Forest Service classifies the condition of subwatersheds into one of three condition classes based on the quality of aquatic and terrestrial habitat: Functioning Properly, Functioning at Risk, or Impaired. With the exception of Arroyo Hondo (which is Functioning Properly), all the project subwatersheds are functioning at risk. See Section 3.6 for more information about watershed conditions.

Desired Conditions

Watersheds would exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Watershed function would be at or moving toward satisfactory and properly functioning conditions. Vegetative structure, soil condition, species diversity and ecosystem resiliency to wildfire, flooding, drought, and other stressors would align with parameters previously described. Watersheds would contain the proper abundance and diversity of native vegetation that would stabilize the soils, help reduce overland flow, and increase infiltration rates and soil water-holding capacity. This would result in a decrease of accelerated hillslope erosion, rill formation, headcut formation, and down-cutting of stream channels.

Intermittent and ephemeral streams are found throughout the project area and play an important role in the health of a watershed. The desired condition is to restore the functionality of intermittent and ephemeral streams by promoting vegetative growth of woody and herbaceous native species, reducing coniferous tree encroachment in stream channels, reduce nonnative invasive plants, and increase resiliency to potential future disturbances. It is expected that restored streams would be able to convey water during high precipitation events without accelerated channel deepening, headcut formation, or excess erosion.

1.4.4 Ecological Response Units

ERUs are generally described as vegetative communities or ecosystem types. ERUs are mapped ecosystem types based on biophysical themes that represent the range of conditions (e.g., dominant species, vegetation associations, soils, landscape features, or climate) that prevail under natural disturbance regimes (e.g., fire, insects, and disease). Each ERU has specific seral states that describe smaller units of vegetation conditions and succession (e.g., dominance of post-disturbance species or closed-canopy conditions) that is influenced by both natural processes and management (U.S. Forest Service 2014) (Table 1.3). The following terms may be helpful when reviewing the ERU analysis in this EA:

Canopy cover or closure (%): Canopy closure and canopy cover are two slightly different measures of the forest canopy that determine the amount of light able to penetrate to the forest floor. Canopy cover is the percentage of a given ground area that is covered by the vertical projection of the crowns of trees. Canopy or crown closure is an integrated measure from multiple angles of the canopy over a segment of the sky (hemisphere) above a single point on the ground. Both estimate the amount that tree canopies interlock and cover the ground surface with shade.

Closed: indicates canopy cover greater than 30%.

Open: indicates canopy cover ranging from 10% to 30%.

Seral: a temporal and intermediate stage in the process of succession. The different stages of succession are often referred to as seral stages or states. Developmental stages are as follows:

early seral: Communities that occur early in the successional path and generally have less complex structural developmental than other successional communities. Seedling and sapling size classes are an example of early seral forests.

mid-seral: Communities that occur in the middle of the successional path. For forests, this usually corresponds to the pole or medium sawtimber growth stages.

late seral: Communities that occur in the later stage of the successional path with mature, generally larger individuals, such as mature forests.

Table 1.3. Seral State Definitions Used Throughout this EA

Seral State	Description	Vegetation Cover and Structure
Grass, forb, shrub-early	Non-tree: recently burned; grass, forb, and shrub types; seedling/sapling tree sizes	All cover classes, all storiedness
Mid-Open	Small trees, open canopy	10%–29.9% tree cover, all storiedness
Mid-Closed	Small trees, closed canopy	>30% tree cover, all storiedness
Late-Open	Medium to large trees, open canopy	10%–30% tree cover, 3+ stories
Late-Closed	Medium to large trees, closed canopy	>30% tree cover, all storiedness

Additional terminology is defined in the glossary found in Chapter 6.

The existing and desired conditions described below are organized by each ERU that is proposed for forest resiliency treatment. The proposed treatments described in Chapter 2 for the Proposed Action are also based on the unit of ERU.

Desired conditions for each ERU within the project area are based on the current 2022 SFNF Forest Plan, General Technical Report GTR-RMRS-310 (Reynolds et al. 2013), the U.S. Forest Service Southwestern Region desired condition guidance (U.S. Forest Service 2014), the 2012 MSO Recovery Plan (U.S. Fish and Wildlife Service [USFWS] 2012), and the management recommendations for the northern goshawk (U.S. Forest Service 1992). Figure 1.4 and Table 1.1 (above in Section 1.3) also inform the ERUs within the project area.

Mixed Conifer-Frequent Fire Forest

EXISTING CONDITIONS

Mixed conifer-frequent fire is the most prevalent ecological vegetation type found in the project area, at approximately 17,875 acres. Fire exclusion and past management practices have contributed to higher stand densities and altered species compositions from mature, large ponderosa pines and Douglas fir to more shade-tolerant, less fire-resistant species such as white fir (Moore et al. 2004; Romme et al. 2009). ERU stands are denser and more overstocked (80% of the “closed” state compared with 28% as desired). A much larger component of this ERU is dominated by smaller trees as opposed to larger trees. Current densities in this vegetation type have approximately 503 trees per acre (TPA) and an average basal area (BA) of 157. These stands are primarily even-aged and lack structural diversity.

DESIRED CONDITIONS

MIXED CONIFER-FREQUENT FIRE FOREST: LANDSCAPE-SCALE DESIRED CONDITIONS

The mixed conifer-frequent fire vegetation community would be composed of multiple species of varying ages in a mosaic of seral states and structures. The forest arrangement on the landscape would be similar to historic patterns, with groups and patches generally of variably sized and aged trees (uneven-aged) and occasional patches of even-aged structure interspersed within variably sized openings of grass-forb-shrub vegetation. Denser tree conditions would exist in some locations such as north-facing slopes and canyon bottoms. Canopies would generally be more open than in mixed conifer with aspen stands. Table 1.4 summarizes the existing and desired seral state proportions for the mixed conifer-frequent fire ERU (U.S. Forest Service 2022b).

Table 1.4. Existing and Desired Seral State Proportions for Mixed Conifer-Frequent Fire Forest

Seral State	Existing Seral State (% of ERU)	Desired Seral State (% of ERU)	Description	Tree Size Class (diameter in inches)	Vegetation Cover and Structure
Grass, forb, shrub-early	1	9	Non-tree: recently burned; grass, forb, and shrub types; seedling/sapling tree sizes	0–4.9	All cover classes, all storiedness
Mid-Open	0	3	Small trees, open canopy	5–9.9	10%–29.9% tree cover, all storiedness
Mid-Closed	47	3	Small trees, closed canopy	5–9.9	>30% tree cover, all storiedness
Late-Open	7	60	Medium to large trees, open canopy	10–19.9 and >20	10%–30% tree cover, 3+ stories
Late-Closed	45	25	Medium to large trees, closed canopy	10–19.9 and >20	>30% tree cover, all storiedness

Sources: U.S. Forest Service (2022b)

Groups of mixed conifer-frequent fire forest would vary in size (although typically small groups), shape, number of trees per group, and number of groups per area across the landscape, creating a mosaic of patchiness. Where they naturally occur, groups of aspen and all structural stages of oak would be present. The vegetation community would be composed predominantly of vigorous trees, but older declining, top-killed, lightning- and fire-scarred trees would be a component that provide snags and coarse woody debris (more than 3-inch diameter), all well-distributed throughout the landscape. The understory would consist of native grass, forbs, and shrubs (U.S. Forest Service 2022b).

Vegetation conditions (composition, structure, and function) would be broadly resilient to disturbances of varying frequency, extent, and severity, and to climate variability. The forest landscape would be a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g., insects, diseases, fire, and wind), including old trees, downed logs, and snags. Fire and other disturbances would be sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling (U.S. Forest Service 2022b).

Frequent, low-severity fires (Regime I) would be characteristic in this type, including throughout goshawk home ranges. Fire return interval would be 5 to 21 years. Grasses, forbs, shrubs, needle cast (fine fuels), and small trees would maintain the natural fire regime (U.S. Forest Service 2022b).

MIXED CONIFER-FREQUENT FIRE FOREST: MID-SCALE DESIRED CONDITIONS

At the mid-scale, the size and number of tree groups and patches would vary depending on disturbance, elevation, soil type, aspect, and site productivity. The more biologically productive sites would contain more trees per group and more groups per area. Groups and patches of trees would be primarily uneven- aged with all age classes and structures present. Disturbances would sustain the overall variation in age and structural distribution. Occasionally small patches (generally less than 60 acres) of even-aged forest structure would be present, based on disturbance events and regeneration establishment. A small percentage of the landscape may be predisposed to larger even-aged patches, based on physical site conditions that favor mixed-severity and stand-replacement fire, and other disturbances (U.S. Forest Service 2022b).

Tree density within forested areas would generally range from 30 to 125 square feet per acre BA. Openness typically would range from 50% in more productive sites to 90% in the less productive sites. Following major disturbances, grass-forb-shrub interspaces may comprise 10% to 100% of the mid-scale areas, depending on the type and time of disturbance (U.S. Forest Service 2022b).

Snags would typically be 18 inches or larger at the diameter at breast height (dbh) and average 3 per acre. Smaller snags, 8 inches and larger at dbh, would average 8 snags per acre. Coarse woody debris, including downed logs, would typically range from 5 to 15 tons per acre. Downed logs (larger than 12- inch diameter at mid-point, over 8 feet long) would average 3 per acre within forested areas of the landscape. Ground cover would consist primarily of perennial grasses and forbs capable of carrying surface fire, with basal vegetation values ranging between about 5% and 20%. Fires would burn primarily on the forest floor and would not spread between tree groups as crown fire (U.S. Forest Service 2022b).

Forest conditions in goshawk post-fledging areas would be similar to general forest conditions, except they typically contain 10% to 20% higher BA in mid-old age tree groups than goshawk foraging areas and the general forest. Nest areas would have multi-aged forest conditions, with dominant large trees and relatively denser canopies compared to the rest of the mixed conifer-frequent fire type (U.S. Forest Service 2022b).

MIXED CONIFER-FREQUENT FIRE FOREST: FINE-SCALE DESIRED CONDITIONS

Trees typically would occur in irregularly shaped groups and would be variably spaced with some tight clumps. Trees within groups would be of similar or variable ages and of one or more species. Crowns of trees within mid-aged and old groups would be interlocking or nearly interlocking. Size of tree groups would be typically less than 1 acre. Groups at the mid to old-age stages would consist of 2 to approximately 50 trees per group, but would sometimes larger, such as on north-facing slopes. Regeneration openings would occur as a mosaic and similar in size to nearby groups. Interspaces surrounding groups would be variably shaped, composed of a native grass-forb- shrub mix, and may contain individual trees or snags (U.S. Forest Service 2022b).

Ponderosa Pine Forest

EXISTING CONDITIONS

Ponderosa pine is the second most dominant vegetation type found across the project area, comprising approximately 34%, or 17,365 acres. The dominant species in this vegetation type is ponderosa pine, but Gambel oak (*Quercus gambelii*), pinyon pine, one seed juniper (*Juniperus monosperma*), and Rocky Mountain juniper (*Juniperus scopulorum*) may also be present depending on elevation and aspect. Ponderosa pine forest evolved with low-intensity frequent fires which maintained a variable patch sizes with open to closed canopies. Currently this vegetation type is highly departed from historical conditions with homogenous, closed canopy tree patches with very little variation in age-classes. Ponderosa pine is also deficient in large old trees and snags (dead trees >18 inches dbh) and highly departed from historic fuel loading conditions.

Current densities in this vegetation type have approximately 543 TPA and an average BA of 142. These stands are primarily even-aged and lack structural diversity.

DESIRED CONDITIONS

PONDEROSA PINE: LANDSCAPE-SCALE DESIRED CONDITIONS

The ponderosa pine forest vegetation community would be composed of trees of varying ages in a mosaic of seral states and structures. The forest arrangement on the landscape would be similar to historic patterns, with groups and patches generally of variably sized and aged trees (uneven-aged) and occasional patches of even-aged structure, interspersed within variably sized openings of grass-forb shrub vegetation associations. Denser stand conditions would exist in some locations, such as north-facing slopes and canyon bottoms. Table 1.5 summarizes the existing and desired seral state proportions for the ponderosa pine forest ERU (U.S. Forest Service 2022b).

Table 1.5. Existing and Desired Seral State Proportions for Ponderosa Pine Forest

Seral State	Existing Seral State (% of ERU)	Desired Seral State (% of ERU)	Description	Tree Size Class (diameter in inches)	Vegetation Cover and Structure
Grass, forb, shrub-early	13	2	Non-tree: recently burned; grass, forb, and shrub types; seedling/sapling tree sizes	0–4.9	All cover classes, all storiedness
Mid-Open	1	2	Small trees, open canopy	5–9.9	10%–29.9% tree cover, all storiedness
Mid-Closed	40	2	Small trees, closed canopy	5–9.9	>30% tree cover, all storiedness
Late-Open	7	82	Medium to large trees, open canopy	10–19.9 and >20	10%–30% tree cover, 3+ stories
Late-Closed	39	12	Medium to large trees, closed canopy	10–19.9 and >20	>30% tree cover, all storiedness

Source: U.S. Forest Service (2022b)

Groups of ponderosa pine forest would vary in size (although typically small), shape, number of trees per group, and number of groups per area across the landscape, creating a mosaic of patchiness. Where they naturally occur, in the Gambel oak sub-type, all structural stages of oak trees would be present (U.S. Forest Service 2022b).

The ponderosa pine forest vegetation community would be predominantly composed of vigorous trees, but older declining, top-killed, lightning- and fire-scarred trees would be a component that provides for snags and course woody debris (over 3-inch diameter), all well-disturbed throughout the landscape. Dwarf-mistletoe would occur in less than 15% of host trees in uneven-aged forest structures and less than 25% in even-aged forest structures.

Frequent, low-severity fires (Fire Regime I) would be characteristic in this type, including throughout goshawk home ranges, with fire return intervals of 4 to 30 years. Fires would burn primarily on the forest floor and would not spread between tree groups as crown fire. Grasses, forbs, shrubs, litter, and small trees would maintain the natural fire regime (U.S. Forest Service 2022b).

Vegetative conditions (composition, structure, and function) would be broadly resilient to disturbances of varying frequency, extent, severity, and to climate variability. The forest landscape would be a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g., insects, diseases, fire, and wind), including old trees, downed logs, and snags. Natural and human-caused disturbances would be sufficient to maintain desired overall tree density, structure, species compositions, coarse woody debris, and nutrient cycling (U.S. Forest Service 2022b).

PONDEROSA PINE: MID-SCALE DESIRED CONDITIONS

At the mid-scale, the size and number of tree groups and patches would vary depending on disturbance, elevation, soil type, aspect, and site productivity. The more biologically productive sites would contain more trees per group and more groups per area, resulting in less space between groups. Mosaics of tree groups and patches of trees would make up an uneven-aged forest with all age classes present. Disturbances would sustain the overall variation in age and structural distribution (U.S. Forest Service 2022b).

Density within the forested areas would range from 22 to 89 square foot BA per acre. Openness typically would range from 52% in more productive sites to 90% in less productive sites. In areas with high fine-scale aggregation of tress into groups, mid-scale openness ranges between 78% and 90%. Ponderosa pine snags would typically be 18 inches or larger at dbh an average 1 to 2 per acre. In the Gambel oak subtype, large oak snags (larger than 10 inches) would be well-distributed component (U.S. Forest Service2022b).

Coarse woody debris, including downed logs, would vary by seral state but would typically range from 3 to 10 tons per acre. Downed logs (larger than 12-inch diameter at mid-point, over 8 feet long) would average 3 logs per acre within the forested area (not interspaces) of the landscape. Ground cover would consist primarily of perennial grasses and forbs capable of carrying surface fire, with basal vegetation values ranging between about 5% and 20% (U.S. Forest Service 2022b).

Fires would burn predominantly on the forest floor and do not spread between tree groups as crown fire (U.S. Forest Service 2022b).

Forest conditions in goshawk post-fledging areas would be similar to general forest conditions, except they would typically contain 10% to 20% higher BA to mid- to old-age tree groups than goshawk foraging areas and the general forest. Nest areas would have multi-aged forest conditions, with dominant large trees and relatively denser canopies compared to other areas of the ponderosa pine forest type (U.S. Forest Service 2022b).

PONDEROSA PINE: FINE-SCALE DESIRED CONDITIONS

Tree groups are typically less than 1 acre, but averages 0.5 acre and are sometimes larger on north-facing slopes. In mid-aged and older forests, groups would consist of approximately 2 to 40 trees. Trees would typically occur in irregularly shaped groups and variably spaced with some tight clumps. Trees within groups may vary in age and sometimes contain species other than ponderosa pine. Crowns of trees within the mid- to old-age groups would be interlocking or nearly interlocking. Interspaces surrounding groups would be variably shaped, are a native grass-forb-shrub mix, and may contain individual trees or snags (U.S. Forest Service 2022b).

Pinyon-Juniper Woodlands, Pinyon-Juniper Grasslands, and Juniper Grasslands

EXISTING CONDITIONS

Pinyon-juniper woodlands and grasslands can be found in the lower elevations and southern aspects in mid-elevations. Both pinion-juniper woodlands and pinyon-juniper grasslands are comprised of species including two needle pinyon (*Pinus edulis*), one seed juniper, Utah juniper (*Juniperus osteosperma*), and occasionally alligator juniper (*Juniperus deppeana*). Where these vegetation types differ the most is in their representation on the landscape, pinyon-juniper grassland making up far less of the vegetation type (2.6% on the SFNF) and pinyon-juniper woodland (13.8%) and their canopy closure. Pinyon-juniper grassland has a relatively open canopy but with higher densities of smaller trees and underrepresentation of larger trees. The pinyon-juniper woodlands ERU has a varying canopy closure ranging from open grass-forb to mature closed canopy. Pinyon-juniper woodlands are the least departed from historic conditions in terms of stand structure. Both vegetation types are highly departed in fuel loadings (large increases from historic conditions) and lack of understory herbaceous ground cover.

DESIRED CONDITIONS

For SFMLRP, the desired conditions for this ERU group, consisting of pinyon-juniper woodlands, pinyon-juniper grasslands, and juniper grasslands, is primarily to mitigate future fire behavior from potential crown fire to surface fire, with lower flame lengths and rates of spread. Higher canopy base heights lower surface fuel loading, and greater canopy spacing reduces fuel continuity, which limits large wildfire spread into adjacent communities, mitigating impacts to values at risk. Refer to Section 1.4.1 for a detailed discussion of desired conditions for fire regimes and hazards for this ERU group.

Riparian Ecosystems

EXISTING CONDITIONS

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. Most of the riparian areas are characteristically dominated by deciduous tree species like cottonwoods, willows, and alders, as well as shrubs (Triepke et al. 2018); however, in many areas these species are being crowded out and over-topped by conifer species. There is a need to improve riparian vegetation where conditions are departed and conifers are encroaching.

The increasingly dense vegetation and conversion from deciduous species to conifers also places riparian areas at risk of damage from intense wildfires. In general, riparian areas are adapted to fire; a natural fire with predominately low severities should be quickly followed by natural recovery (LANDFIRE 2010; Stromberg and Ortiz-Zuazaga 1998; Wright and Bailey 1982). With fire exclusion and denser vegetation, wildfires are expected to burn hotter and with more severity than historic fires. The higher fire intensity could limit recovery potential and increase runoff, erosion and sediment transfer following a wildfire. This would expose riparian areas to encroachment of non-native invasive species, increased water temperatures, and conversions to more shrubby vegetation rather than trees, which would negatively impact water quality and quantity.

DESIRED CONDITIONS

Riparian ecosystems would support the distribution, diversity, and complexity of watershed and watershed-scale features that in turn support species, populations, and local communities. The system's ability to support unique physical and biological attributes and the diversity of associated species would be sustained by necessary soil, hydrologic regime, vegetation, and water characteristics.

The ecological function of riparian areas would be resilient to disturbance including fire and animal and human use. Compared to surrounding uplands, riparian corridors would have reduced fire frequency and severity (Dwire et al. 2016; Everett et al. 2003; Skinner 2003) owing to characteristics including surface water and saturated soils. High severity fire is infrequent and patchy, and riparian corridors are resilient and able to recover following fire. Regeneration, growth, and persistence of obligate vegetation would be ensured by natural variation in depth to groundwater, volume of surface water, and timing and the magnitude of their fluctuations (Auchincloss et al. 2013; Horton et al. 2001; Smith et al. 2018; Stromberg et al. 1997). Flooding and scour would occur at a frequency and magnitude characteristic of riparian corridors so that flooding and scour support the regeneration of native phreatophyte vegetation.

A diverse vegetation structure, including mature trees, snags, logs, and coarse woody debris, would be present to provide habitat for riparian-dependent species. The species structural diversity of native plant communities in riparian areas would provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration. Riparian woody regeneration would be sustainable, approximating reference conditions according to the overall percentage of early-mid seral states.

The amount, spatial distributions, and sizes of coarse woody debris and fine particulate organic matter would be sufficient to sustain physical complexity and stability. The amount of coarse woody debris is similar to reference condition (low departure) and is adequately recruited to sustain replacement.

Riparian vegetation would consist mostly of native species that support a wide range of vertebrate and invertebrate species; invasive plant and animal species are rare or absent. Riparian ecosystems would have a diverse composition of desirable native plants that contain a mosaic of communities, creating a structurally robust vegetative network that protects the soils from unnatural erosion. Departure from site potential would be low (less than 33%) (U.S. Forest Service 2015a). Woody vegetation within forested and shrubland riparian areas and wetland ecosystems would display a variety of size classes; they provide terrestrial and aquatic habitats, stream shading (temperature regulation), woody channel debris, aesthetic values, and other ecosystem functions. Invasive species are absent. Riparian communities would be free from encroachment by upland species and the extent of riparian communities is expanding or has achieved potential extent (U.S. Forest Service 2022b).

Riparian areas would be capable of filtering sediment and aiding floodplain development that contribute to water retention and groundwater recharge along with providing slope stability and associated vegetative root strength, wood delivery to streams, input of leaf and organic matter to aquatic and terrestrial systems, solar shading, microclimate, and improved water quality.

Spatial connectivity would be provided within or between watersheds and, where appropriate, riparian ecosystems provide connectivity important for dispersal, access to new habitats, perpetuation of genetic diversity as well as nesting and foraging for special status species. Within riparian ecosystems connectivity is exhibited between and within aquatic, riparian, and upland components that reflect their natural linkages and range of variability. Lateral, longitudinal and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact habitat refugia. These network connections provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic, riparian-dependent, and many upland species of plants and animals.

1.4.5 Wildlife Habitat

Existing Conditions

A number of wildlife species are known to occur in the project area including nine (9) At Risk species; (8) Species of Conservation Concern (SCC) (Appendix B), such as northern goshawk, and one additional special-status species, MSO (*Strix occidentalis lucida*), a federally threatened species.

The project area can continue to provide habitat and species viability for At-Risk species if habitats are maintained to improve resiliency. Forests, woodlands, riparian areas, and grasslands within the project area have changed over time and trend toward unnaturally high tree density, lack of open tree canopies, and a lack of large old trees (old growth), which have led to reduced understory productivity and diversity. The trend toward increased densities of smaller trees and conifer encroachment/infill has contributed to increased vertical fuel continuity. With these trends, wildlife habitats are changing, becoming less suitable as diversity decreases, conifer density increases, and the risk for large, high-intensity, high-severity wildfires increases across the Forest. The current risk for large, high-severity fire also poses a substantial threat to MSO habitats across the project area.

This current forest condition limits the diversity and quality of wildlife habitat. Areas characterized by unnaturally dense forested stands and a closed canopy structure offer habitat for some species such as MSOs but are poor habitat for many species that rely on a healthy understory for forage such as ungulates, small mammals and wild turkey. There is a need to maintain or enhance native understory vegetation and a diversity of habitat components for the wide array of species that utilize this area.

Desired Conditions

Overall, the desired condition in reference to wildlife is a resilient forest ecosystem with a mosaic of site-appropriate vegetation types consisting of a diversity of vegetation species, sizes, age classes, densities and distributions, which provides an array of habitat for the species that use the project area. Achieving the desired conditions outlined above for the ERUs (see Section 1.4.4) would also improve wildlife habitat. For example, creating more open stand conditions and openings would stimulate the growth of an herbaceous understory that provides forage, while still retaining areas of denser growth and closed canopy would maintain habitat for species like MSO. Restoring forest structure with multiple age classes and retaining snags would also provide a diversity of habitat types for general wildlife species. Similarly, reaching the desired conditions for wildfire risk would also help protect wildlife habitat from being destroyed in a catastrophic wildfire.

MEXICAN SPOTTED OWL

The project area lies with the Southern Rocky Mountains ecological management unit (SRM EMU) for the MSO. EMUs are geographical subdivisions of the owl range established by the U.S. Fish and Wildlife Service (USFWS) to organize owl recovery efforts. At the time of publication of the MSO Recovery Plan, the SRM EMU contained approximately 5.6% of MSO owl sites known to occur in the U.S. and in Mexico (USFWS 2012). Recovery habitat is defined as MSO habitat outside of protected activity centers (PACs) occurring in mixed conifer, ponderosa pine-oak, riparian forests, and/or rocky canyons (USFWS 2012). Forested recovery habitat includes mixed conifer and pine-oak forests outside of PACs. Mixed conifer forest is the primary habitat type used by MSO in the project area for nesting, roosting, foraging, dispersal, and/or other life history needs. Ponderosa pine forest and other habitats, such as pinyon-juniper, are used for foraging, dispersal, and wintering. Mixed conifer is used by the MSO for all activities. Desired conditions for each MSO habitat are outlined in the MSO Recovery Plan (USFWS 2012). Desired conditions for the applicable MSO habitat types present within the proposed project area are summarized in Appendix A and further discussed in the Threatened and Endangered species section of this document.

SPECIES OF CONSERVATION CONCERN

Desired conditions for SCC are found within the 2022 Forest Plan (U.S. Forest Service 2022b) and are addressed in the SCC Forest Plan Consistency Report (Appendix B).

1.5 Decision Framework

The SFNF Supervisor is the responsible official and deciding officer for this project. The Forest Supervisor will make the following decisions:

- Whether or not or to what degree to conduct vegetation management and improve wildlife habitat and watersheds within the project area.
- Based on the analysis, select the Proposed Action or other action alternative that has been considered in detail, or modify an action alternative. Identify the design criteria and any mitigation measures to be applied during project implementation.
- Whether to not approve the proposal and require the effects of the Proposed Action to be analyzed through an EIS.

1.6 Public Involvement and Tribal Consultation

The SFMLRP was developed over several years in close coordination with partners in the Greater Santa Fe Fireshed Coalition (GSFFC), including other federal agencies, state, county, local and Tribal governments, and non-governmental organizations (NGO) and other community groups who worked collaboratively to develop the proposal. A total of 16,501 acres within the Fireshed have already been treated with more treatments planned, under earlier environmental analyses under the National Environmental Policy Act (NEPA). This includes acres treated within the Santa Fe Municipal Watershed.

During the 37-day scoping period, which began on June 10, 2019, and ended on July 17, 2019, SFNF personnel engaged in numerous outreach efforts, including hosting two public meetings, publishing news releases, and disseminating a scoping document for public review and comment. The two public meetings were held on Monday, June 24, 2019, and Saturday, June 29, 2019.

This Draft EA was released for a 30-day public comment period in September 2021, following a 10-day publication period from September 13 through 23, 2021. The EA was posted on the SFNF website: https://www.fs.usda.gov/project/?project=55088. Two virtual public meetings will be held during the public comment period, as advertised on the SFNF website.

A Final EA, Draft DN FONSI and 45-day objection period was released on March 28th, 2022. On July 27th, 2022, during the Regional Office objection review the Regional Forester directed the SFNF to withdrawal the Final EA and DN FONSI for the Santa Fe Mountain Resiliency Project. Correspondence was sent out to inform objectors, partners, and the public about the decision on July 28th, 2022 informing on the withdrawal and plans moving forward.

On July 28, 2022, the SFNF withdrew the draft decision notice for the final EA for the SFMLRP to focus all resources on the suppression of the Hermits Peak-Calf Canyon Fire. The pause also provided additional time to reengage with partners and raise public awareness of the urgent need for forest and watershed restoration in the Sangre de Cristo Mountains adjacent to Santa Fe.

Since July, the SFNF has participated in several meetings, discussions, and listening sessions regarding the SFMLRP. Participants in these events included, but were not limited to, the general public and community members, Santa Fe Board of Commissioners, GSFFC, NGOs, and other state and local entities. Public engagement is an integral part of the success of the implementation of the SFMLRP and will continue throughout implementation.

As part of the NEPA scoping process, consultation letters were mailed to eight Pueblos: Cochiti Pueblo, Nambe Pueblo, Ohkay Owingeh Pueblo, Pojoaque Pueblo, San Ildefonso Pueblo, Santa Clara Pueblo, Santo Domingo Pueblo, and Pueblo of Tesuque. Pueblo of Tesuque provided a comment letter in response to scoping. The Pueblo Governor Milton Herrera expressed support the forest restoration approach of the SFNF to protect Tesuque ancestral homelands. He stated also that Pueblo of Tesuque considers all of the Sangre de Cristo Mountains as a Traditional Cultural Property (TCP). Specific sacred site locations were not disclosed by the pueblo. Concerns about limited recreational access as well as the impact of grazing and the creation of new roads were also raised in this letter. Additional consultation and tribal input would be sought by SFNF during each phase of this project and prior to implementation of vegetation thinning, use of prescribed fire, riparian restoration, and road closure treatments (U.S. Forest Service 2021c).

On September 22, 2021, the SFNF mailed letters of notice regarding the availability of the draft EA to 10 tribes: Cochiti, Jemez, Nambe, Ohkay Owingeh, Picuris, Tesuque?, Pojoaque, San Ildefonso, Santa Clara, Santo Domingo, and Taos.

On November 2, 2021, SFMLRP was one of two projects presented virtually to their full tribal council.

On December 16, 2021, the SFNF Heritage Program provided copies of cultural resource inventory reports and documents associated with the Ski Santa Fe area and the SFMLRP boundary per the request of Tesuque Pueblo. An external jump drive with electronic/digitized copies of 36 reports/documents was physically mailed to Governor Mark Mitchell and Tribal Historic Preservation Officer (THPO) Larry Samuel.

On August 31, 2022, the SFNF met with the Pueblo of Tesuque Tribal Council to discuss the July withdrawal of the draft decision notice and final EA. The release of the EA and draft DN was also discussed with tribal representatives at the September, 2022 SFFC quarterly meeting.

These are the issues/ concerns raised during the scoping and public comment periods.

Table 1.6. Issues Addressed in the EA

Issue Category	Issue Description	EA Section where the Issue is Addressed
Planning & Public Involvement	The U.S. Forest Service needs to provide the public with more opportunities for involvement.	Section 1.7 Public Involvement and Tribal Consultation
Planning & Public Involvement	The U.S. Forest Service needs to prepare an environmental impact statement.	Summary
Modified Proposed Action or Alternative	The Proposed Action should be more site-specific.	Section 2.1.2—see the description of the conditions-based management approach
Modified Proposed Action or Alternative	The U.S. Forest Service should develop a detailed monitoring plan to accompany the Proposed Action.	Appendix D: Draft Monitoring Plan
Modified Proposed Action or Alternative	The U.S. Forest Service should limit treatments in the inventoried roadless areas (IRAs).	Section 3.14 Inventoried Roadless Areas
Modified Proposed Action or Alternative	The U.S. Forest Service should limit thinning of large and old trees.	Table 2.3
Modified Proposed Action or Alternative	The U.S. Forest Service should use a strategic approach to implementing treatments where they would be the most effective.	Section 2.1.2—see the description of the conditions-based management approach
Impacts Analysis	How would the proposed treatments address silvicultural	Section 3.2 Vegetation Communities

	concerns?	
Impacts Analysis	How would the proposed treatments address forest health?	Section 3.2 Vegetation Communities
Impacts Analysis	How would the proposed treatments affect upland vegetation?	Section 3.2 Vegetation Communities
Impacts Analysis	How would the proposed treatments affect old growth?	Section 3.2 Vegetation Communities
Impacts Analysis	How would the site-specific amendments to the Forest Plan affect MSO and northern goshawk habitat?	Section 3.2 Vegetation Communities
Impacts Analysis	How effective would treatments be/how likely would treatments be to improve ecosystem resilience over time?	Section 3.3 Fire and Fuels
Impacts Analysis	What model of risk assessment was used and would be used to determine treatment locations?	Section 3.3 Fire and Fuels
Impacts Analysis	How would the proposed project impact various MSO habitat types?	Section 3.4 Threatened and Endangered Species
Impacts Analysis	Is the proposed project compliant with the USFWS 2012 MSO recovery plan?	Section 3.4 Threatened and Endangered Species
Impacts Analysis	How would the proposed project impact northern goshawk habitat?	Section 3.5 Flora and Fauna
Impacts Analysis	How would the proposed project impact U.S. Forest Service management indicator species?	Section 3.5 Flora and Fauna
Impact Analysis	Is the proposed project in compliance with the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act?	Section 3.5 Flora and Fauna
Impacts Analysis	Would project activities degrade soil productivity by disturbing, compacting, and sterilizing the soil?	Section 3.6 Watersheds and Hydrology
Impacts Analysis	Would project activities cause increased peak stream flows, which may flood private property and infrastructure downstream?	Section 3.6 Watersheds and Hydrology
Impacts Analysis	Would project activities degrade water quality through physical and chemical processes that add pollutants to water?	Section 3.6 Watersheds and Hydrology
Impacts Analysis	How would the proposed treatments affect conifer overabundance in riparian areas?	Section 3.7 Riparian Resources
Impacts Analysis	How would the proposed treatments affect the current overabundance of late seral conditions in riparian areas?	Section 3.7 Riparian Resources
Impacts Analysis	How would the proposed prescribed fire treatments affect riparian vegetation?	Section 3.7 Riparian Resources
Impacts Analysis	How would the proposed treatments contribute to global climate change?	Section 3.8 Air Quality and Climate
Impacts Analysis	How would the proposed prescribed burning associated with the proposed treatments impact local air quality?	Section 3.8 Air Quality and Climate
Impacts Analysis	How would the proposed treatments impact public access for recreation in the project area?	Section 3.9 Recreation
Impacts Analysis	How would the proposed treatments impact the scenic quality of the project area?	Section 3.10 Scenery
Impacts Analysis	How would the proposed treatments impact heritage resources in the project area?	Section 3.11 Heritage Resources
Impacts Analysis	How would the project treatments impact traditional cultural uses within the project area?	Section 3.12 Tribal and Traditional Uses
Impacts Analysis	How would livestock grazing impact the effectiveness of the proposed treatments?	Section 3.13 Range Resources
Impacts Analysis	How would the proposed project treatments impact livestock grazing within the project area?	Section 3.13 Range Resources
Impacts Analysis	How would the proposed treatments impact the character of the IRAs within the project area?	Section 3.14 Inventoried Roadless Areas

1.7 Summary

Through this environmental assessment (EA), the Española and Pecos-Las Vegas Ranger Districts of the Santa Fe National Forest (SFNF) are proposing the Santa Fe Mountains Landscape Resiliency Project (project), which involves prescribed fire and vegetation thinning treatments. The purpose of the project is to improve the ecosystem resilience of a priority landscape to future disturbances by restoring forest structure and composition and reducing the risk of catastrophic wildfire. Activities analyzed in this EA are proposed on 36,680 acres of the 50,566-acre planning area of U.S. Forest Service lands.

The U.S. Forest Service has prepared this EA in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This EA discloses the direct, indirect, and cumulative environmental impacts that would result from the Proposed Action and alternatives. The EA will be used to determine the level of impacts from the proposed project. If significant impacts are identified, the U.S. Forest Service will prepare an environmental impact statement (EIS) (40 Code of Federal Regulations [CFR] 1501). The document is organized into four parts:

- **Chapter 1 Purpose and Need:** This chapter includes background information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that need. This section also details how the U.S. Forest Service informed the public of the proposal and how the public responded.
- **Chapter 2 Alternatives:** This chapter provides a detailed description of the agency's Proposed Action for achieving the stated need, including project design features and mitigation measures, and a description of the No Action Alternative which also serves as the baseline to compare and contrast with the Proposed Action.
- **Chapter 3 Affected Environment and Environmental Consequences:** This chapter describes environmental effects of implementing the Proposed Action and No Action Alternative. This analysis is organized by affected resource area. Within each resource section, the affected environment is described first, followed by effects of the No Action Alternative that provides a baseline for evaluation and comparison to the effects of the Proposed Action, which is described last.
- **Chapter 4 Consultation and Coordination:** This chapter provides a list of preparers, agencies, and tribes consulted during the development of this EA.
- **Chapter 5 Literature Cited:** This chapter provides a full list of citations provided in the EA.
- **Chapter 6 Glossary:** This chapter defines key technical terms used in the EA.
- **Appendix A:** Mexican Spotted Owl (MSO) Desired Conditions
- **Appendix B:** Species of Conservation Concern Report
- **Appendix C:** Design Features, Best Management Practices, and Mitigation Measures
- **Appendix D:** Monitoring Plan
- **Appendix E:** Strategy for Avoiding Cumulative Watershed Effects
- **Appendix F:** Public Comment Period Content Analysis and Response
- **Appendix G:** Table A-1. Comment Coding Structure
- **Appendix H**: Table B-1. Draft Environmental Assessment Comments Received
- **Appendix I:** Literature Cited

Chapter 2. Alternatives

This chapter provides a detailed description of the Proposed Action as well as alternatives to the Proposed Action. The Proposed Action and alternatives were developed based on collaborative planning, IDT meetings, and comments from the public. This section also contains a comparative summary of the alternatives.

Two alternatives were considered in detail for this project:

2.1 Alternatives Considered in Detail

- Alternative 1 – No Action
- Alternative 2 – Proposed Action

2.1.1 Alternative 1 – No Action

U.S. Forest Service NEPA regulations allow an EA to document consideration of a No Action Alternative through the effects analysis by contrasting the impacts of the Proposed Action with the current condition and expected future conditions if the Proposed Action were not implemented (CFR 220.7(b)(2)(ii)). The EA will include an analysis of the No Action Alternative to provide a baseline for comparing the effects of the modified Proposed Action and a clear description of why the No Action Alternative would not meet the purpose and need for the project.

Under the No Action Alternative, current management plans would not authorize any specific actions and continue to guide the management of the project area. No prescribed burning, vegetation and restoration treatments, or road maintenance would be implemented to accomplish project goals within the project area, unless approved through a separate NEPA document and decision.

2.2 Santa Fe Forest Plan Direction

The analysis in this EA is required in order to ensure proposed activities are moving toward desired conditions and consistent with the standards and guidelines of the Forest Plan (U.S. Forest Service 2022b). The SFMLRP Interdisciplinary Team (IDT) has reviewed Forest Plan guidelines, standards, and management approach to determine compliance of the proposed project with the Forest Plan. Information on compliance with the Forest Plan is documented in the Forest Compliance Report and also found in each specialist report for the resources analyzed in this EA. This information is available on the project website under the “Analysis” tab:

https://www.fs.usda.gov/project/?project=55088

The desired conditions summarized above in Section 1.4 reflect the desired conditions in the 2022 Forest Plan (U.S. Forest Service 2022b).

To further meet project goals, the Proposed Action includes a project-specific amendment to the Forest Plan that would authorize the use of forest treatment strategies in places and under conditions that were not foreseen when the current Forest Plan standards and guidelines were established in 1987. The purpose of this amendment is to implement updated management direction for the MSO, based on the

2012 MSO Recovery Plan, and updated management direction for northern goshawks, based on the best available science (see Section 2.2 and Appendix C).

A project-specific plan amendment is a one-time variance in Forest Plan direction. Forest Plan standards and guidelines revert back to the original language for all other ongoing or future projects that may be authorized on the Santa Fe National Forest unless additional amendments are made for those other projects. If adopted, this would be the eighteenth amendment to the Forest Plan since its inception in 1987 (Appendix E).

Although the current Forest Plan is under revision, we anticipate that the project decision will be completed prior to the release of the revised Forest Plan. Therefore, an amendment to the current plan is required for the project to be implemented as described. The project is expected to be consistent with the revised Forest Plan when it is finalized.

The proposed amendment described in Section 2.2 and in Appendix E does not propose changes in management area boundaries but would modify Forest Plan standards and guidelines so new controls and technologies can be utilized where appropriate.

2.2.1 Alternative 2 – Proposed Action

In response to the purpose and need, the U.S. Forest Service proposes to conduct restoration activities on approximately 38,680 acres within the 50,566-acre planning area in the Santa Fe Mountains over the next 10 to 15 years to meet initial project objectives, with additional prescribed fire maintenance treatments beyond 20 years. Restoration activities would occur in multiple ERUs, including mixed conifer-frequent fire forest, ponderosa pine forest, pinyon-juniper woodlands and grasslands, and riparian areas. Restoration activities would focus on vegetation thinning and prescribed fire treatments to improve forest resiliency by reducing stand density, stand continuity, and stand homogeneity (sameness of forest structure and species composition), and increase heterogeneity (diverse forest structure and species composition) at a landscape scale, mid-scale, and fine scale.

The Proposed Action is designed to provide a wide range of restoration methods that could be used to achieve desired conditions at the fine scale, mid-scale, and landscape scale. Each restoration method has a related set of tools that may be used on any given location depending on the characteristics of the specific treatment site, such as vegetation type, topography, presence of federally listed species, etc. This approach provides flexibility and is known as conditions-based management. Condition-based management is defined by the U.S. Forest Service as a management approach which supports responsiveness and flexibility between planning and implementation in natural resource management. Condition-based management allows for proposed treatments to be aligned—post-decision but prior to implementation—with current conditions on the ground. It does this by focusing on the collecting of the right data and the right time for the right activity to meet the land management decision. For the project, those intended outcomes are the desired conditions presented in Section 1.4.

Condition-based management (CBM) stems from the recognition that the environment is dynamic, changing as ecosystems respond over time to changing natural and human-caused events. The U.S. Forest Service would apply the most appropriate tool or combination of tools to achieve desired results. Before carrying out treatments, project leaders would look at the specific area to be treated and select the appropriate treatment tool(s) using an interdisciplinary resource review process. Potential treatment tools developed using CBM criteria are described in detail in the following sections. Table 2.1 provides a general overview of the restoration methods and associated tools that could be used to implement the proposed project. The sections below provide greater detail about the proposed restoration methods and tools.

Table 2.1. Summary of Restoration Methods and Associated Activities that Comprise the Proposed Action

Restoration Method/ Associated Activities	Tools to be Used for Implementation	Total Acres or Miles Proposed for Treatment
Vegetation Thinning using Thin from Below	Hand thinning Manual harvesting using chainsaws Mechanical methods such as mastication	18,000 acres
Use of Prescribed Fire	Broadcast burning Pile burning Jackpot burning	38,000 acres
Riparian Restoration	Conifer and non-native species removal Indirect use of prescribed fire Native tree planting Fencing	680 acres 17 miles of stream
Road Closure	Closure of 1.5 miles along Forest Service Road 79W	1.5 miles

Conditions-Based Management Approach for Proposed Vegetation Thinning and Prescribed Burn Treatments

The Proposed Action does not define specific treatment units, but rather general areas throughout the project area where treatments would be most likely to occur and the suite of tools that would be used. A central component of the purpose and need for this project is to move the landscape closer to desired conditions through the safe reintroduction of fire as an ecological process to frequent-fire adapted systems. It is imperative that prescribed fire be implemented in a manner that is safe for firefighters while protecting valued resources.

Vegetation thinning (both manual and mechanical) treatments and prescribed burning are two methods that would be implemented to meet the purpose and need. The decision-making process and framework that U.S. Forest Service practitioners utilize to choose where, when, and to what extent these tools are utilized and implemented follows a generalized and logical pattern. The U.S. Forest Service does not have complete information regarding the conditions found on every acre of the project footprint, however sufficient information exists to make informed decisions about the types of treatments that work best in certain conditions, as well as make informed estimates so that the effects of those treatments can be disclosed in this document.

In order to implement the Proposed Action, the U.S. Forest Service would follow the validation process outlined below to evaluate on-the-ground conditions that would inform the appropriate forest treatments and prescriptions to be applied in specific locations within the project area to move towards desired conditions described in Chapter 1:

1. **Identify treatment area boundary and conduct field reconnaissance and inventory.** The type of reconnaissance and inventory protocol required depends on the forest characteristics within the treatment area (e.g., homogeneity of stand conditions) and the availability of existing data (e.g., common stand exams).
2. **Coordinate with resource specialists and applicable partnering agencies to determine the appropriate design features and mitigation measures necessary to implement proposed treatment(s).** Prior to treatment implementation the U.S. Forest Service will coordinate with resources specialists (i.e., wildlife biologist, hydrologist, archaeologist, recreation specialist) to determine any applicable design features to be implemented (see Appendix C).
3. **Conduct a review for MSO nest/roost habitat and PACs and complete the U.S. Forest Service MSO Habitat Project Checklist to ensure compatibility of treatments with the MSO Recovery Plan.** A minimum of two years of inventory to USFWS protocol standards is required within mixed-conifer vegetation suitable for MSO nesting and roosting before project implementation. Surveys for additional nesting or roosting sites in the project area are ongoing and would be completed before implementation of activities in an area. If owls are found and a PAC is established, appropriate measures would be followed as described in the recovery plan and the design features, such as determining the PAC status (nesting, non-nesting or absence) for the year using USFWS standards and breeding season restrictions.
4. **Consider any previous forest restoration treatments or disturbed areas that could be used to build a prescribed fire burn boundary and identify safe anchor points that would facilitate the implementation of prescribed fire.** This is an iterative and adaptive process that builds from continuing treatments as the project progresses. For example, once a ‘first-entry’ prescribed burn is completed in a given area, the outcome of the treatment is considered for the next burn block.
5. **Define prescribed fire unit boundary using topography, vegetation/fuel condition, and proximity to previously treated or disturbed areas that provide safe anchor points.** Prescribed fire units would typically be defined by ridgelines, spur ridges, valley/canyon bottoms, existing roads and natural barriers. Hand or machine firelines would also be used on ridgelines, spur ridges, valley/canyon bottoms to create a prescribed fire perimeter.
6. **As necessary, vegetation thinning would be required to prepare a prescribed fire unit boundary necessary for safe and effective implementation.** The amount of thinning required for prescribed fire unit preparation depends primarily upon vegetation conditions and topography. In general, the approach is to do the least amount of thinning necessary to ensure safety and meet resource objectives.
7. **As necessary, delineate thinning units within the burn block to facilitate the reintroduction of fire and move the landscape closer to desired conditions.** Treatment might include thinning and hand piling, followed by a piling burning treatment prior to implementing a broadcast burn on the larger block. Table 2.2 below provides a guide for the vegetation characteristics that would be evaluated by the U.S. Forest Service to determine if vegetation thinning is needed prior to safely introducing prescribed fire on the landscape.

Table 2.2. Vegetation Characteristics Suitable for Consideration of Vegetation Thinning Treatments by ERU

ERU(s)	Basal Area (square feet/acre)	Trees per Acre	Quadratic Mean Diameter (inches)	Canopy Cover (%)	Canopy Base Height (feet)
Mixed Conifer–Frequent Fire	≥70	≥500	<6.0	>30	<8
Ponderosa Pine	≥60	≥500	<6.0	>30	<8
Pinyon-Juniper Woodland, Pinyon-Juniper Grassland, and Juniper Grasslands	≥60	≥400	<7.0	>30	<4

Note: Stand conditions need not meet all above thresholds in order to be considered for treatment.

To move the forest stands within the project area toward the desired condition of uneven-aged stand structure, as described in EA Chapter 1, thin from below treatments would be applied where needed, followed by prescribed fire treatments. All treatment areas may be entered multiple times to meet the desired conditions. Prescribed fire would be the primary tool used to reduce tree densities and undesirable tree regeneration and promote grasses and forbs. An example of the conditions-based management approach described above may include the following scenario: within a prescribed burn block, stand reconnaissance and inventory show that several stands are overly dense and have a high probability of tree crowning and/or torching. Implementation of prescribed fire from the perimeter of the burn block may be acceptable to the U.S. Forest Service practitioner(s) to ensure safety and protection of adjacent resources, however the extent of potential mid- and high- severity fire is considered unacceptable. In this instance, the U.S. Forest Service could opt to treat stands interior to the burn block as a means to manipulate fuel conditions to reduce risk of tree crowning and/or torching.

Figure 2.1 and Figure 2.2 illustrate potential vegetation thinning and prescribed fire treatment units that could be delineated for the project area. It is important to note that proposed conditions-based treatments would not be limited to individual polygons as displayed in these figures. Rather, they represent the U.S. Forest Service's best estimate of existing conditions that warrant vegetation thinning or prescribed fire treatments, or both. The actual location of forest treatments would occur where deemed appropriate at the time of implementation and would follow the conditions-based management approach described in this chapter of the EA.

Acreage amounts would not exceed the Proposed Action acreages presented in Table 2.1 above. All actions would be conducted in accordance with 2022 Forest Plan direction, and all applicable laws, regulations, and policies. Thinned material would be made available for fuelwood collection where feasible and in line with other resource objectives. No mechanical equipment would be used on slopes greater than 40 percent. No new roads or temporary roads would be constructed.

For a variety of factors, including but not limited to, smoke impacts, costs of treatment, impacts to the affected environment, capital resources, and human resources, the U.S. Forest Service estimates that no more than 750 acres per year would be treated with manual or mechanical vegetation thinning and no more than 4,000 acres per year would be treated by the use of prescribed fire. However, if factors such as funding, technology and weather allow for moving ahead at a greater pace without exceeding the impacts described in this document, the intention is to implement this project as soon as it can be completed.

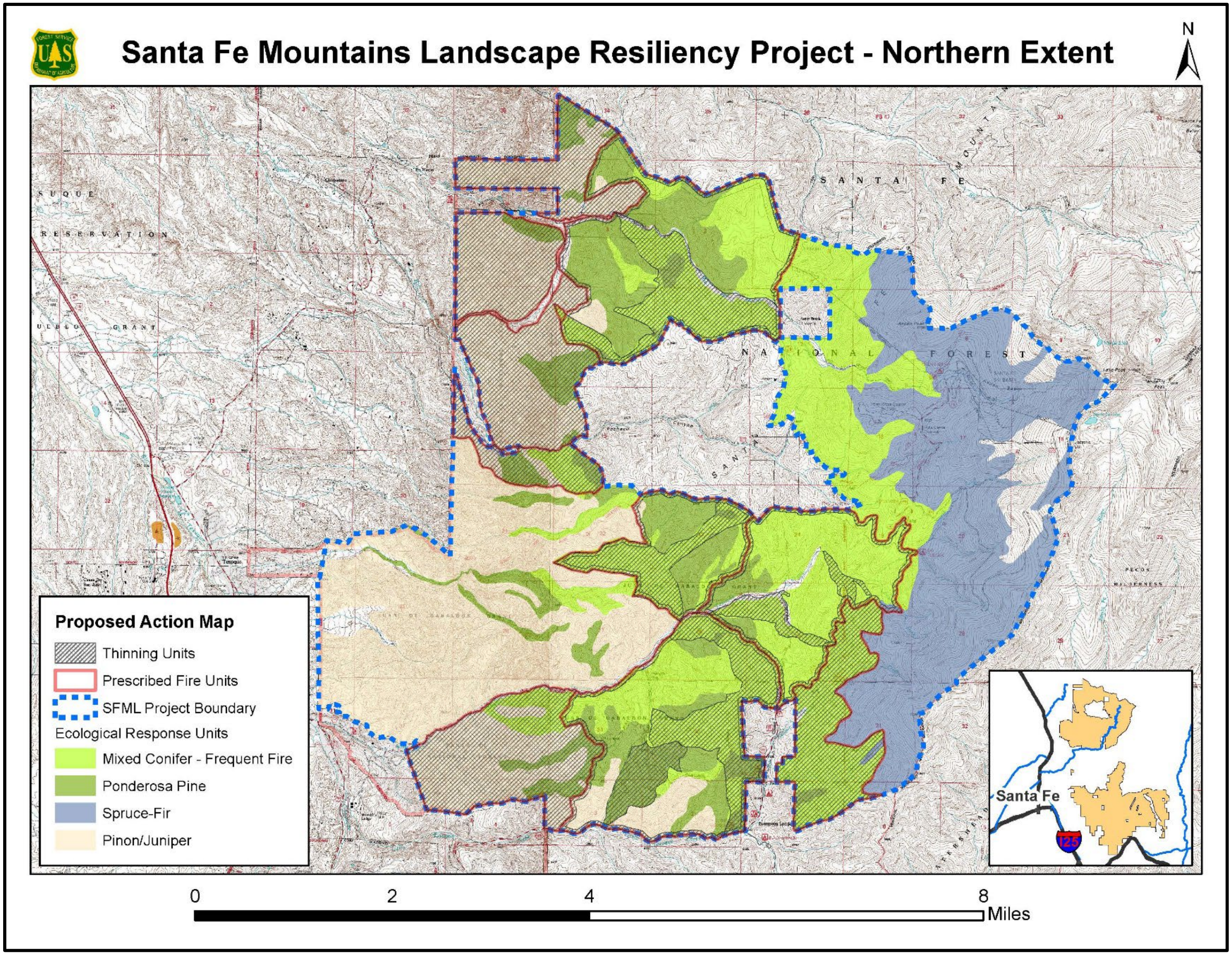


Figure 2.1. Potential vegetation thinning and prescribed fire treatment units for the northern portion of the project area.

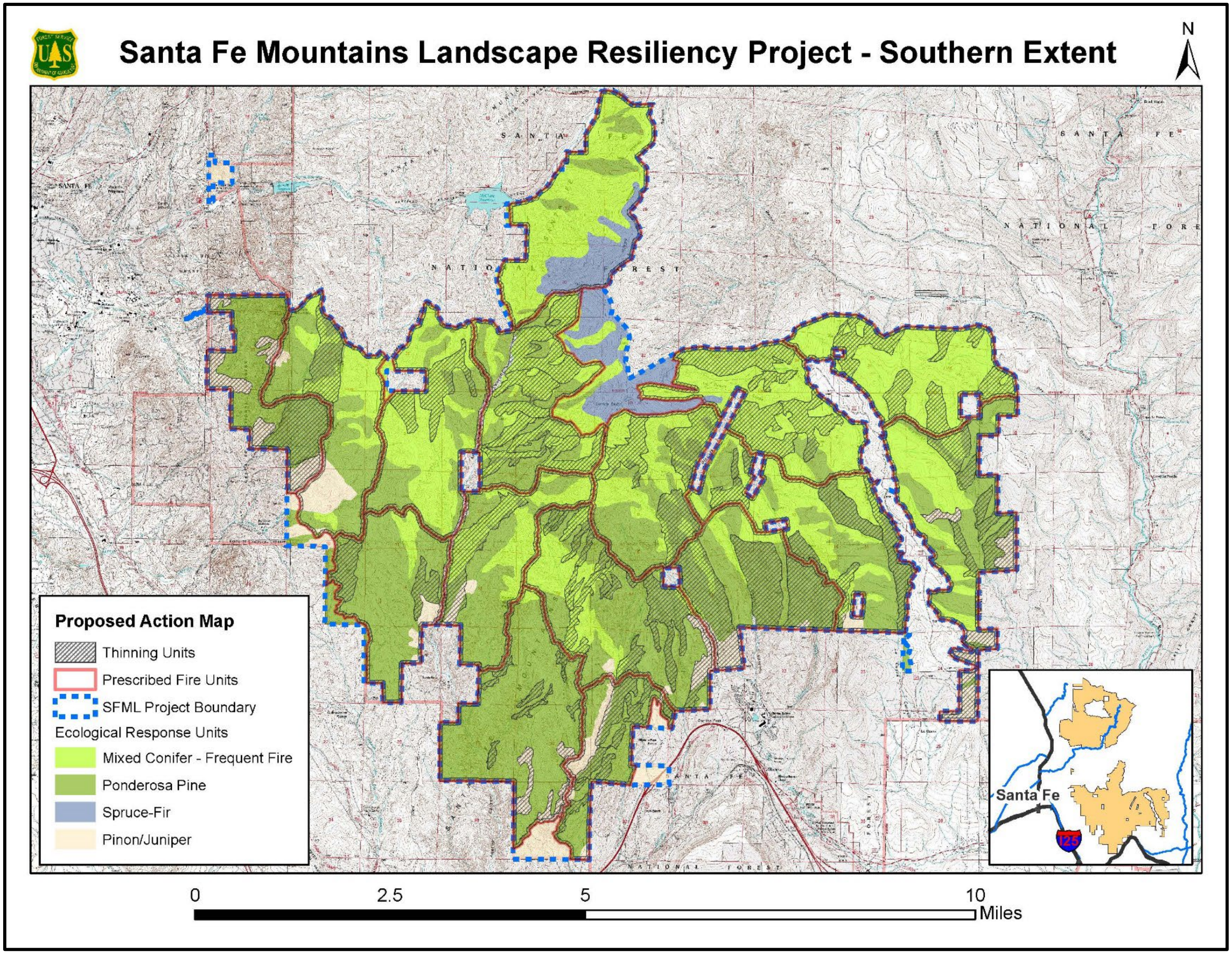


Figure 2.2. Potential vegetation thinning and prescribed fire treatment units for the southern portion of the project area.

Vegetation Thinning Treatments

Manual and mechanical vegetation thinning treatment methods would include but are not limited to the following: the use of chainsaws to cut trees and distribute slash, masticators to thin trees and manipulate slash material, excavators for machine piling of slash and fire-line construction. Other specialized equipment may be used to treat the fuels to meet resource objectives. No mechanical equipment would be used on slopes greater than 40 percent. Lop and scatter or piling of thinned material would occur depending upon site conditions. Forest products would not be generated as a part of this project with the exception of fuelwood where conditions allow and do not conflict with resource objectives.

Table 2.3 displays the maximum acres proposed for vegetation thinning treatment for each ERU. The text following the table provides a brief description of the proposed silvicultural prescriptions to be applied in the project area. The silvicultural prescriptions would be further refined through site-specific assessments prior to implementation.

Table 2.3. ERUs Proposed for Vegetation Thinning Treatments

ERU(s)	Total Area within SFMLRP Footprint (acres)	Total Area Proposed for Thinning from Below to a Target BA (16-inch dbh/12-inch drc limit) (acres)
Mixed Conifer–Frequent Fire	17,875	7,500
Ponderosa Pine	17,347	6,500
Pinyon-Juniper Woodland, Pinyon-Juniper Grassland, and Juniper Grasslands	8,660	4,000
Spruce-Fir	5,022	-
Montane/Subalpine Grassland	491	-
Mixed Conifer with Aspen	456	-
Narrowleaf Cottonwood/Shrub	680	-
Colorado Plateau/Great Basin Grassland	139	-
Alpine and Tundra	63	-
Total	**50,556**	**18,000**

Note: dbh = diameter at breast height; drc = diameter at root collar

Thin from below would be used to improve tree growth, tree vigor, and create stand structure that would meet uneven-aged desired conditions by removing unhealthy, intermediate, and suppressed trees and providing more growing space for the residual trees. The primary purpose is to reduce fuel continuity and modify fuel arrangement. Uneven-aged structure would be emphasized by implementing treatments to create openings, break stand continuity, and allow for regeneration of site-appropriate vegetation. Understory and mid-story trees would be left in place, where needed, to achieve uneven-aged forest structure. Conifers within grasslands and meadows would be cut to allow for open conditions that promote grasses and forbs.

No trees with diameters greater than 16-inch dbh or 12-inch diameter at root collar (drc) for juniper species (*Juniperus* spp.) and two needle pinyon would be cut under this alternative. It is important to note that the conditions-based approach described above would be followed to determine the tree diameter limit to be applied to a specific treatment unit. Not all treatment units would require that a 16-inch dbh or 12-inch drc limit to meet treatment objectives. In all likelihood, site-specific treatments and prescriptions may utilize a smaller tree diameter limit.

VEGETATION THINNING TREATMENTS WITHIN MEXICAN SPOTTED OWL RECOVERY HABITAT AND PROTECTED ACTIVITY CENTERS

Vegetation thinning within or adjacent to MSO PACs would be avoided to the greatest extent practicable. However, through the conditions-based management approach described above, the U.S. Forest Service may evaluate forest stand conditions within or adjacent to MSO PACs that require vegetation thinning treatment in order to reintroduce prescribed fire safely and effectively in a treatment unit (Table 2.4). In those cases, the same general thin from below to a target BA silvicultural strategy would be followed within or adjacent to MSO PACs. Within MSO PACs (outside of nest cores), vegetation thinning treatments would be limited to the removal of trees less than or equal to 9 inches dbh to address ladder fuel concerns within a PAC.

Table 2.4. Summary of Vegetation Thinning and Prescribed Fire Treatments in MSO Habitat

Treatment	Quantity (acres)	MSO PACs (acres)	MSO Critical Habitat (acres)	MSO Nest Roost (acres)
Vegetation Thinning using Thin from Below	18,000	929	807	2,234
Use of Prescribed Fire	38,000	2,024	1,953	4,226

Notes:
1. There is overlap between MSO habitat types and treatment prescriptions. All areas proposed for vegetation thinning also fall within area proposed for prescribed fire.
2. A database of designated habitat (as amended per ground surveys and treatment prescriptions) would be maintained for the life of the project.
3. MSO habitat within the project would be continuously updated including the identification of new PACs and updates to habitat models to inform future treatments in alignment with the conditions-based approach. Acreage estimates are based on best available data at the time of the Environmental Assessment and serve as a tool to estimate affects to resources.

Appendix C provides design features to be implemented for the project relative to MSO.

Use of Prescribed Fire

There are two classes of wildland fire: planned (i.e., prescribed fire) and unplanned (wildfire). Prescribed fire (also called controlled or prescribed burning) refers to deliberately burning wildland fuels in either their natural or a modified state and under specified environmental conditions, which allows the fire to be confined to a predetermined area and produces the fireline intensity and rate of spread required to attain planned resource management objectives (Helms 1998).

Broadcast, maintenance, jackpot, and pile burning are all types of prescribed fire activity proposed for the project. Natural and existing features such as rocky slopes and travel routes may be used as prescribed fire containment lines. There is the potential need to construct firelines via hand tools or mechanized equipment in order to confine fires to predetermined areas. Table 2.5 summarizes the proposed prescribed fire treatment acreages within the project area by ERU.

Table 2.5. Proposed Prescribed Fire Treatments by ERU

Ecological Response Unit(s)	Total Area within SFMLRP Footprint (acres)	Area Proposed for Use of Prescribed Fire (acres)
Mixed Conifer–Frequent Fire	17,875	17,000
Ponderosa Pine	17,347	17,000

Ecological Response Unit(s)	Total Area within SFMLRP Footprint (acres)	Area Proposed for Use of Prescribed Fire (acres)
Pinyon-Juniper Woodland, Pinyon-Juniper Grassland, and Juniper Grasslands	8,660	4,000
Spruce-Fir	5,022	-
Montane/Subalpine Grassland	491	-
Mixed Conifer with Aspen	456	-
Narrowleaf Cottonwood/Shrub	503	-
Colorado Plateau/Great Basin Grassland	139	-
Other	63	-
Total	**50,556**	**38,000**

Prescribed fire could be used as a stand-alone restoration treatment or could be used after other vegetation thinning treatments, for example, to remove slash after initial manual and/or mechanical treatments are completed. It could also be used to emulate the role of "natural" fire. Resource protection measures would be applied as appropriate to limit the impacts of prescribed fire on human health and safety, natural resources, and other factors.

Prescribed fires are ignited either by hand or by aerial ignition using a helicopter carrying specialized equipment to ignite surface fuels. The method of ignition for each prescribed burn unit depends on personnel safety, current and predicted weather, topography, vegetation, and the intensity of the fire needed to meet pre-established goals for the burn. Prescribed fires are typically planned during or immediately following monsoon season, during winter, or at other times of the year when fuels and soils have sufficient moisture to reduce damage to the residual trees, to meet resource objectives, and to confine the fire to the desired burn footprint. Burning operations would be limited to air quality and weather conditions, allowing for safe execution of ignition operations with qualified fire personnel from multiple jurisdictions. Prescribed burning would be staggered across treatment units and planned over several burning periods to limit smoke impacts on a given area as much as feasible and as the availability of qualified personnel and funding allows. In order to reduce the potential for soil movement and erosion, no mechanical equipment associated with prescribed fire use would occur on slopes greater than 40 percent.

A prescribed fire plan (burn plan) must be completed prior to the ignition of all planned prescribed fires. Burn plans are official site-specific implementation documents prepared by qualified personnel, approved by the agency administrator, and include criteria for the conditions under which the fire would be conducted to meet management objectives.

There are many potential goals that can be achieved by using prescribed fire. Examples include but are not limited to:

- Reduce surface and ladder fuels that contribute to increased risk of uncharacteristically severe unplanned wildfire.
- Reduce risk and help to safely protect local communities from unplanned wildfire.
- Help protect natural resources such as timber and wildlife critical habitat.
- Promote native species and reduce encroachment of invasive species.
- Enhance landscape resiliency and recovery from an unplanned wildfire.
- Improve firefighter ability to respond safely and effectively to and.

Initial prescribed fire treatment would be followed by maintenance burns approximately every 5 – 10 years.

USE OF PRESCRIBED FIRE IN MEXICAN SPOTTED OWL RECOVERY HABITAT AND PROTECTED ACTIVITY CENTERS

Prescribed fire would be used as needed in MSO PACs, both within and outside of core areas, outside of the MSO breeding season (see Table 2.4). Prescribed burns may be allowed within MSO PACs during the breeding season if the PAC is unoccupied or the owls are not nesting that year, as inferred from results of surveys conducted according to the MSO protocol. Prescribed fire with MSO PACs and recovery nest/roost habitat would be conducted at low intensity with low-severity effects. Dead and down woody material and snags would be retained per current MSO Recovery Plan (USFWS 2021).

Riparian Restoration Treatments

Riparian restoration treatments within an estimated 100-foot buffer of established waterways are proposed along approximately 4.5 miles and 370 acres of Arroyo Hondo (Figure 2.3) and approximately 12.5 miles and 310 acres of Tesuque Creek (Figure 2.4) to improve watershed conditions. In areas where riparian vegetation is in poor condition, or is being encroached by conifers, vegetation thinning, prescribed burning, and native species plantings would occur. The following restoration activities would be implemented within the active floodplain:

- Conifers 12 inches dbh or less would be cut and removed to allow riparian vegetation to thrive and expand.
- Tree boles greater than 3 inches dbh would be left in the floodplain.
- Alder and willow would be cut to stimulate growth, as conditions allow.
- Remaining slash would be lopped and scattered (or piled and burned if fuel loads are high and the terrain allows).
- Native species such as willow, cottonwood, alder, grasses, and forbs would be planted if natural regeneration is determined to be insufficient following conifer and non-native species removal.

The following restoration activities would be implemented outside of the active floodplain, but within the 100-foot buffer around riparian areas:

- Where deciduous trees exist, all conifers 12 inches dbh or less would be cut and removed to allow riparian vegetation to thrive and expand.
- Where deciduous trees do not exist, all conifers 5 inches dbh or less would be cut and removed.
- Alder and willow would be cut to stimulate growth, as conditions allow.
- Remaining slash would be lopped and scattered or piled and burned.
- Native species such as willow, cottonwood, alder, grasses, and forbs would be planted if natural regeneration is determined to be insufficient following conifer and non-native species removal.

Both within and outside of active floodplains, prescribed fire would be indirectly introduced by allowing low-intensity prescribed fire to back down into the riparian areas from upland areas. This indirect use of prescribed fire would reduce understory fuels and promote riparian vegetation growth.

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.

Riparian restoration treatments would follow the conditions-based management approach described in EA section 2.2.1.

Road Usage

The Santa Fe National Forest classifies maintenance of National Forest System roads by five levels: 1, 2, 3, 4, and 5 as defined in FSH 7709.59 chapter 60. Maintenance level 1 roads closed to motor vehicle use, but basic custodial maintenance is performed to prevent damage to adjacent resources and to perpetuate the road for future resource management needs. Maintenance level 2 roads are maintained for high-clearance vehicles. Maintenance level 3, 4, and 5 roads are maintained for passage by standard passenger cars during the normal season of use. A maintenance level 1 road requires the least amount of maintenance and gives the user the lowest comfort level; these are closed to public use and open only for administrative purposes such as fire management or vegetation improvement projects(U.S. Forest Service, 2022b). Within the project footprint there are 121.09 miles of FS system roads. There are 25.45 miles of Maintenance Level 1 roads, 94.69 miles of Maintenance Level 2 roads, and 0.29 miles of Maintenance Level 3&4 Level Roads within the SFMLRP footprint. There are 8.23 miles within the project area exclusively within IRAs. Approximately 1.5 miles of Forest Road 79W would be gated and closed for public motorized access, although private landowners would maintain access ((Figure 2.5. Proposed road closure on Forest Service Road 79W). This proposed road closure would help to reduce resource impacts. possibly need to add table to show data.

Roads that are currently closed to the public (Maintenance Level 1) could be utilized to implement treatments. Some roads may require minimum work to gain access and others would require no work. The use of all Maintenance Level Roads or Forest Service system roads after implementation would remain at the same maintenance level as prior to implementation following the standard and guidelines found in the Forest Plan (U.S. Forest Service, 2022b). During project implementation there will be no new roads, no road reconstruction or temporary roads constructed. There are user created roads, trails and routes that may be used to reduce additional resource damage. Overland travel by vehicles that do not require roads (e.g., masticators, UTVs) may occur (U.S. Forest Service 2021l). During implementation, practitioners would use design features to reduce or eliminate impacts including but not limited to; Water-8, Water-11, Thin- 1, Soil-1 thru Soil 4, Soil-7, Rec- 2 thru Rec-5 (Appendix C).

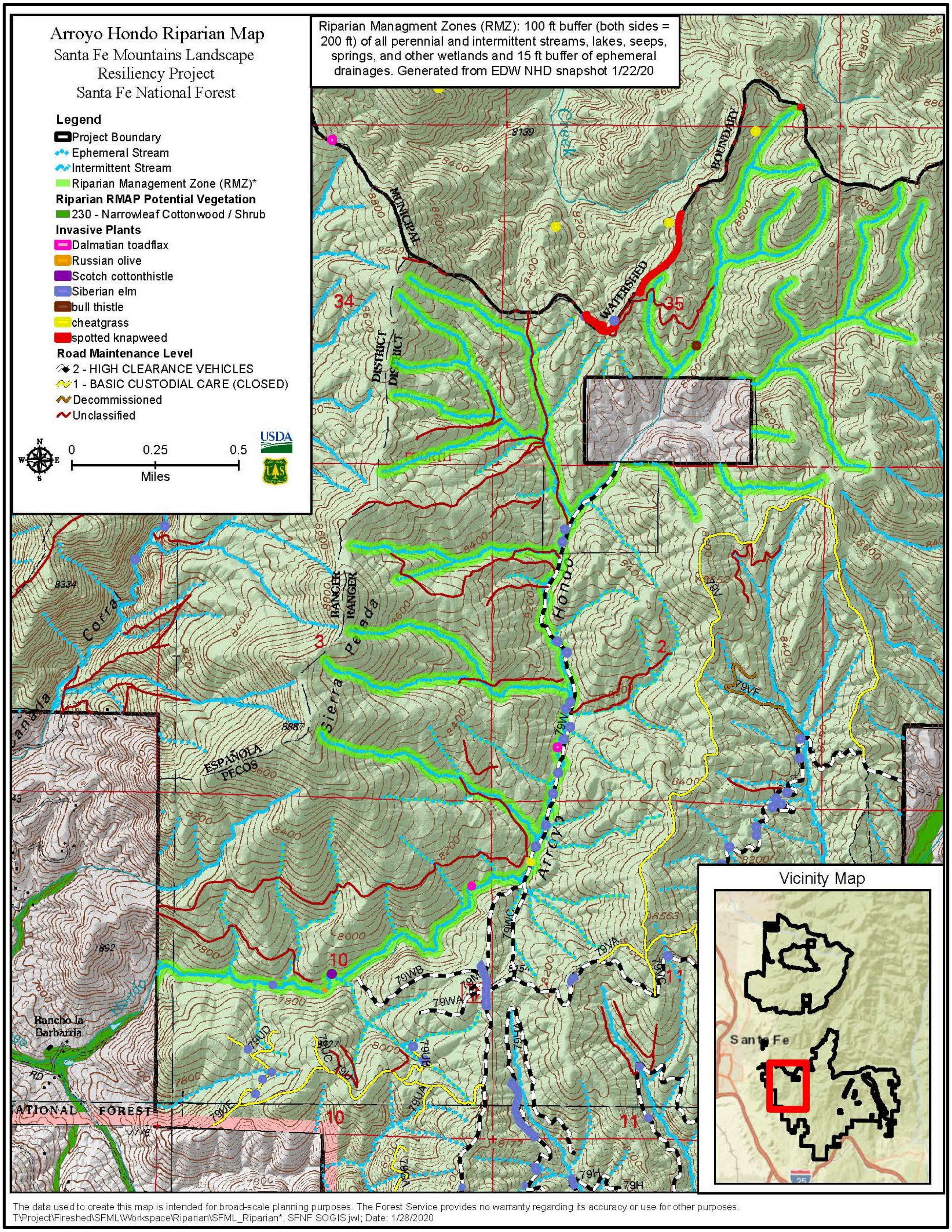


Figure 2.3. Proposed riparian restoration area along Arroyo Hondo.

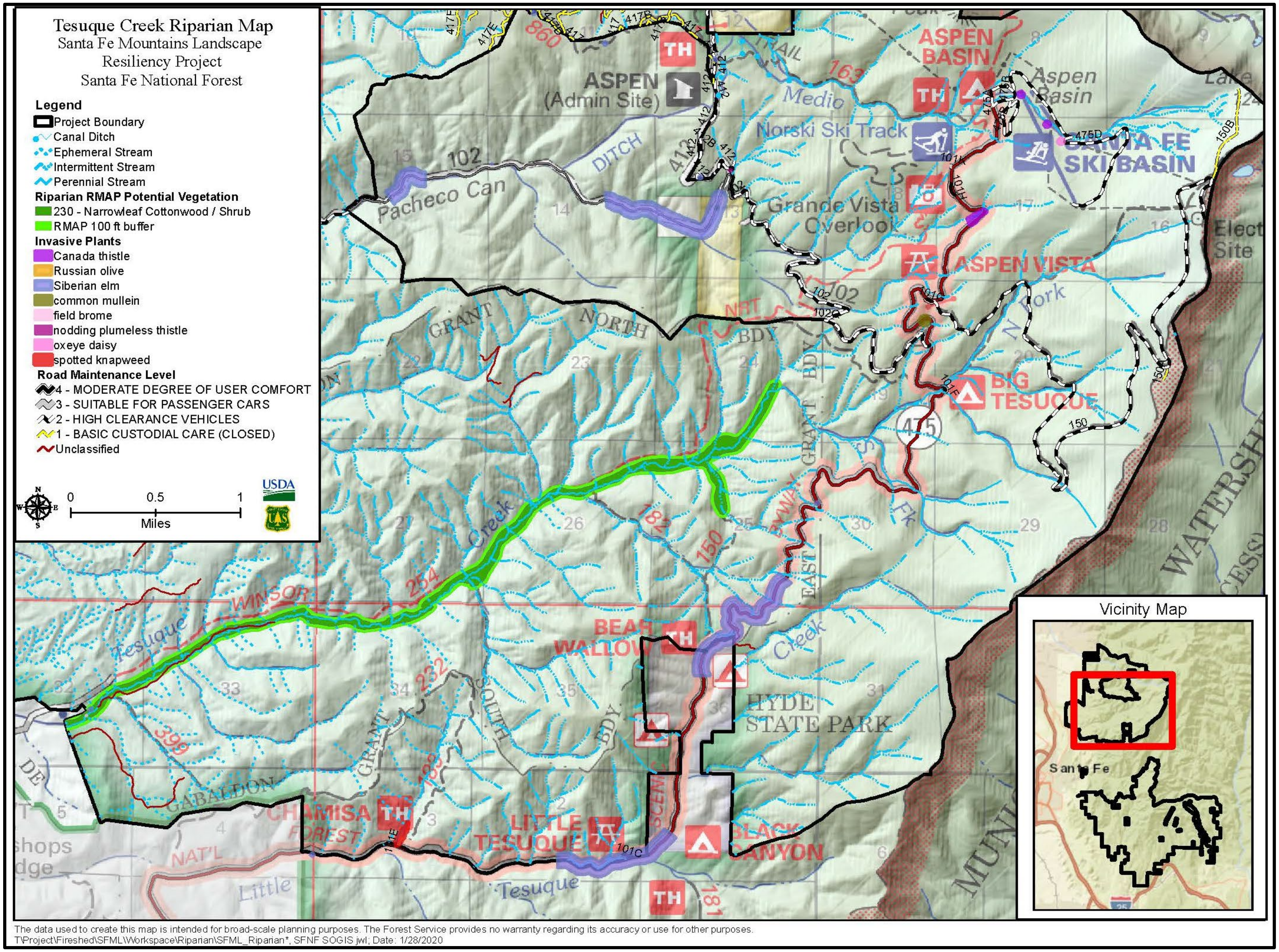


Figure 2.4. Proposed riparian restoration area along Tesuque Creek.

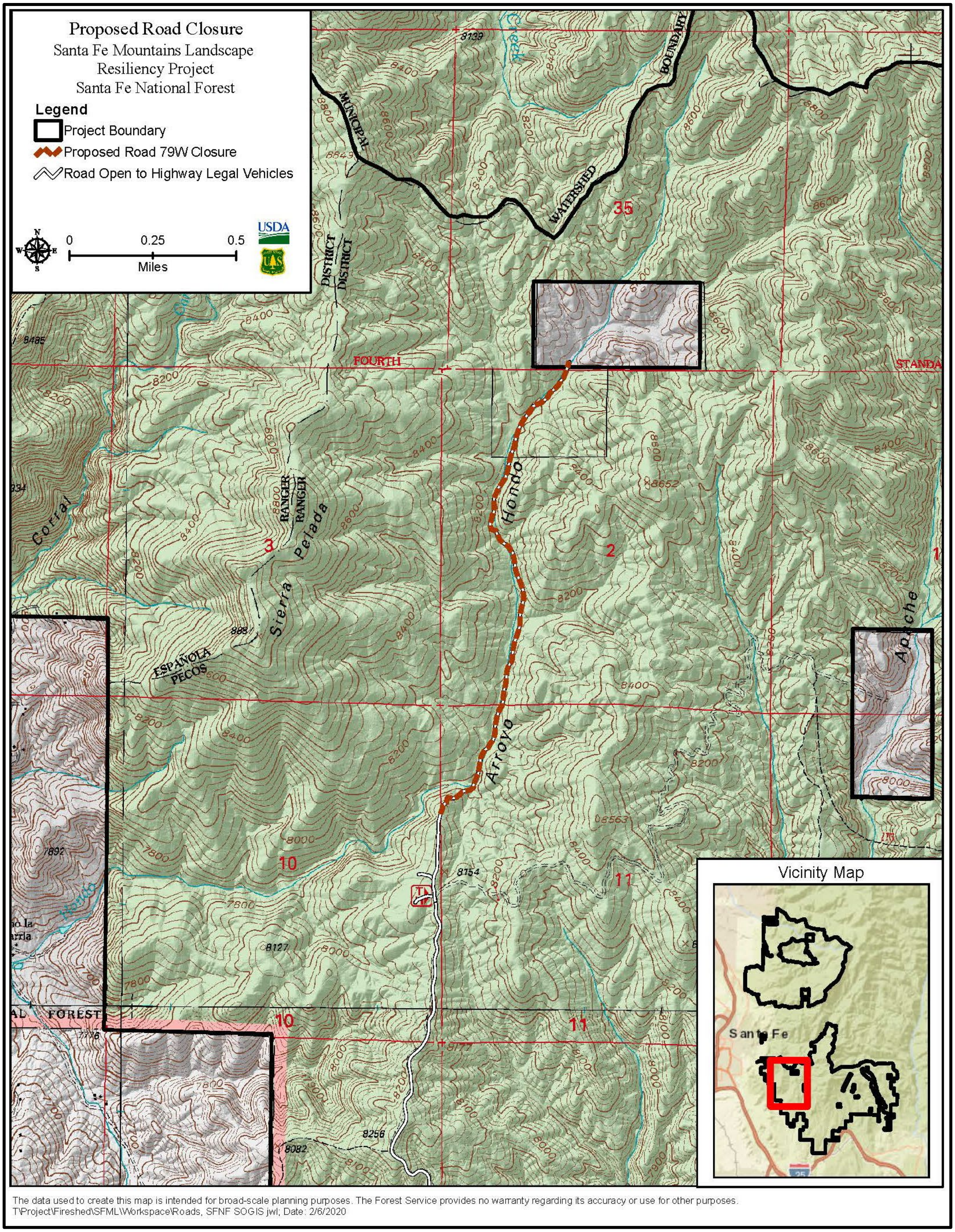


Figure 2.5. Proposed road closure on Forest Service Road 79W.

2.3 Alternatives Considered and Eliminated from Detailed Study

During public scoping, two different alternatives were raised by the public, one referred to as the Strategic Treatments for Fire Use and the other referred to as the Santa Fe Conservation Alternative. Table 2.6 summarizes the various elements of each alternative that the SFMLRP IDT found to be consistent with the SFMLRP Proposed Action.

Table 2.6. Elements of the Recommended Alternatives Addressed by the Proposed Action

	Strategic Treatments for Fire Use	WildEarth Guardians Alternative: Santa Fe Conservation Alternative
Elements of alternative	• Adopt the NM Forest Restoration Principles • Analyze the effects of livestock grazing on the success of treatments • Retain all old (>150 years) and large (>18-inch dbh) trees. • Apply a travel analysis and minimum road system approach to analyze. • Adopt all recommendations of the MSO Recovery Plan (reduces logging impacts to MSO by identifying strategically placed treatment priority areas and allowing natural mixed-severity fire processes to interact with owl habitat). • Do not treat mistletoe or seek to reduce it. • Develop a robust multi-party monitoring framework. • Utilize locally specific reference conditions- usurping GTR - 310.	• Stumps cut to ground. • Identify and protect riparian areas. • Monitor and evaluate slash management to avoid bark beetle impacts. • Monitoring test plots: soil sampling, air quality • Plant native riparian vegetation • Leave most areas accessible for recreation. • Maintain scenic quality of treated areas.

Table 2.7 and Table 2.8 summarize the various elements of each recommended alternative that were found to be inconsistent with the SFMLRP Proposed Action and provides rationale for why that element of the recommended alternative was eliminated from detailed analysis in this EA.

Table 2.7. Elements Proposed under the Strategic Treatments for Fire Use Alternative Categorized by Screening Criteria and Rationale for Dismissal

Does not meet the purpose and need described in EA Ch. 1

Recommended element. Treatment within 0.5 mile around homes and infrastructure.

Rationale for dismissal: SFMLRP is not designed to protect homes in the WUI. Instead, the purpose and need of the project is to increase resiliency across the forest. Treatments in the pinon juniper woodlands ERU will be designed to open canopy, raise base canopy height and reduce fuel loading to provide better opportunity for fire suppression and prevention in WUI landscape. Up to 4000 acres may be treated in the PJ Woodlands ERU.

Alternative is substantially similar to the Proposed Action

Recommended element: Identify areas with degraded soils or plant communities, areas with sensitive soils and areas in need of recovery and reduce and eliminate grazing to contribute to success of treatments.

Rationale for dismissal: The conditions-based management approach described in SFMLRP EA Chapter 2, would be used to identify sensitive areas within SFMLRP treatment areas. Within these sensitive areas, U.S. Forest Service resource specialists and applicable partners would determine the appropriate design features and mitigation measures necessary to implement forest restoration and resiliency treatments. In addition, the SFMLRP EA includes design features intended to avoid, minimize, or mitigate impacts to sensitive soils and plant communities. Continuation of livestock grazing within the SFMLRP project area is unlikely to compromise the success of treatments because there are up to 75 cow-calf pairs authorized to graze within the 50,566-acre project area. For proposed riparian restoration activities within Tesuque Creek and Arroyo Hondo, fencing may be installed, if needed to protect restored areas if it is deemed that riparian vegetation regeneration is being hampered by browsing and grazing.

Recommended element: Utilize locally specific reference conditions- usurping GTR -310.

Rationale for dismissal: Locally specific reference conditions are available and have informed this proposal. In particular, there are good reference condition data from within and adjacent to the project area regarding historic fire regimes. These data have been collected by researchers with the U.S. Geological Survey (USGS) (Margolis and Balmat 2009; USGS 2020).

Although the SFMLRP Proposed Action does not specifically commit the U.S. Forest Service to developing local reference conditions for the Santa Fe Mountains project area, the Proposed Action does not substantially rely on the information provided on GTR-310, referenced as Reynolds et al. 2013 in the EA). Instead, the SFMLRP Proposed Action strikes a balance by using the best available information from several guiding documents and associated datasets, including the 2022 SFNF Forest Plan General Technical Report GTR-RMRS-310 (Reynolds et al. 2013), the U.S. Forest Service Southwestern Region desired condition guidance (U.S. Forest Service 2014), the 2012 MSO Recovery Plan (USFWS 2012), and the management recommendations for the northern goshawk(U.S. Forest Service 1992). Further, to implement the Proposed Action, the U.S. Forest Service would follow the steps outlined in the EA that describe the conditions-based management approach for evaluating on-the-ground conditions that would inform the appropriate forest treatments and prescriptions to be applied in specific locations within the project area to move towards desired conditions that are informed by the documents listed in the preceding sentence.

Alternative is not technically or economically feasible

Recommended element: Permanent fencing of all riparian areas

Rationale for dismissal: Fencing out all riparian areas within the SFMLRP area is not economically feasible or reasonable given that there are only 50 to 75 head of cattle authorized for grazing within the project area. The amount of fencing, associated installation expenses, and potential adverse impacts for fencing substantially outweigh the benefits that would occur from excluding only 75 head of cattle from these areas. Further, the fencing of all riparian areas could restrict wildlife movement through the project area.

Alternative would have effects similar to those of the Proposed Action

Recommended element: Limit to hand thinning only in IRAs

Rationale for dismissal: Based on the IRA review and analysis conducted for the SFMLRP Proposed Action, there would be little, if any, impacts to the nine roadless area values and characteristics identified for IRAs in the project area as defined in the 2001 Roadless Area Conservation Rule. The impacts that have been identified for resources within the IRA are not discernibly different from the rest of the project area. The SFMLRP Proposed Action includes the use of mechanical thinning on slopes less than 40 percent within and outside of IRAs. Therefore, it is reasonable to assume that the limitation of hand thinning only within IRAs would have very similar (meaning none to limited impacts) to the roadless area values and characteristics. As a result, this alternative is not carried forward to for detailed analysis because it would have effects similar to those of an alternative already considered in the EA, the SFMLRP Proposed Action.

Table 2.8. Elements Proposed under the Santa Fe Conservation Alternative Categorized by Screening Criteria and Rationale for Dismissal

Does not meet the purpose and need described in EA Ch. 1

Recommended element: Limit thinning (up to 9-inch dbh) to only dry pine and mixed conifer outside of IRAs. No thinning adjacent to the WUI except within 150 feet of structures and for fire-fighter safety zones.

Rationale for dismissal: Removing understory trees would be effective at reducing the stocking of ladder fuels within treated stands. However, it can be expected that crown bulk densities would not be substantially changed from the implementation of these treatments. As a result, it can be reasonably expected that there would be little to no substantial change on the risk of active crown fire within treated stands following a 9-inch dbh cap. The effects of this treatment are expected to be rather short-lived, meaning effects would diminish as regeneration reestablishes within treated stands.

Recommended element: Maximum trees removed in most thinned areas to 80 BA.

Rationale for dismissal: This recommended alternative element does not take into account the different ERUs that occur in the project area. The recommended 80 BA target may be an acceptable lower limit for a target post-treatment BA range for the spruce-fir and mixed conifer with aspen ERUs, however the target is on the higher end of the desired stocking range for the mixed conifer-frequent fire ERU and just within the desired range for ponderosa pine forest ERU (see inset table below).

ERU	Desired Conditions BA	Post-Thinning Target BA
Spruce-fir	20-250 ft²/ac	N/A
Mixed Conifer with Aspen	20-180 ft²/ac	90-130 ft²/ac
Mixed Conifer-Frequent Fire	30-100 ft²/ac	60-80 ft²/ac
Ponderosa Pine Forests	22-89 ft²/ac	50-70 ft²/ac

Given local growth rates, it can reasonably be expected that stand stocking would be in excess of desired range within 10 to 20 years after initial vegetation thinning treatment of mixed conifer-frequent fire and ponderosa pine stands, depending on factors such as tree size, species composition, and relative health and vigor.

The suggested 80 BA threshold for treatment does not accurately reflect existing conditions and desired conditions within the project area. For example, an even-aged ponderosa pine stand of 5-inch dbh trees could have roughly 600 TPA and be stocked to roughly 80 feet² per acre (80BA). This stand would be at a 44% relative density index (RDI) or percentage of maximum stand density index and would be considered to be "High Density." An even-aged stand of 12-inch dbh ponderosa pine trees would be stocked with approximately 100 TPA. This stand would have a 30% RDI and would be considered to be of "Moderate Density." Finally, a stand of 24-inch dbh ponderosa pine trees would be stocked to approximately 25 TPA, would have an RDI of 24%, and would be considered to be just on the edge of "Low Density" and "Moderate Density." Stands with high RDI are characterized by overcrowding, higher mortality and lower vigor, leading to poor forest health and limited resiliency to disturbance. Thus, a blanket target of 80BA across these

Does not meet the purpose and need described in EA Ch. 1
variables would not be desirable treatment target to meet the purpose and need of the proposed project. Sources used to inform this response are Curtis 1970, Long 1985, and Triepke et al. 2011. Recommended element: Leave tree groupings (50% minimum) and maintain a shrub understory. Rationale for dismissal: The recommendation to leave tree groups of 50% minimum and maintain shrub understory is not consistent with the desired conditions for the project area described in SFMLRP EA Chapter 1. There are 10 different ERUs within the project area with significant variation in structural and species diversity, and native understory composition; the WildEarth Guardians recommendation does not reflect this diversity and the treatment needs necessary to reach desired conditions of all ERUs. The purpose and need for this project is to restore the ecological process of fire to a landscape that has not seen fire in multiple decades. This lack of fire has led to high tree densities that require thinning prior to the safe and effective reintroduction of fire to the landscape. Targeting smaller diameter ladder fuels with thinning facilitates the application of prescribed fire, allows safe access for firefighters and aids in mitigation of crown fire potential. If the intent of this comment is to suggest that less than 50% of the project area be treated, EA Table 2.4 indicates proposed thinning is currently less than 50% of each ERU individually and all ERUs as a whole. Therefore, the SFMLRP is consistent with this recommended alternative element. If the intent of this comment was to suggest that 50% of any particular treatment area be left as tree groupings, then this alternative element would not meet the purpose and need for this project because these conditions would facilitate crown fire spread during a wildfire. Recommended element: Pile burn activity fuels. Rationale for dismissal: The limitation of pile burning only for the disposal of activity fuels would limit the ability of the forest restoration and resiliency treatments to shift the project area towards the desired conditions identified in the SFMLRP EA Chapter 1. The ecological process of fire is thoroughly documented in literature specific to the project area (Margolis and Balmat 2009; USGS 2020). Broadcast prescribed fire would be utilized in frequent fire ERUs where this ecological process is recognized. Recommended element: Utilize managed wildland fire and pile burning. Minimal use of prescribed fire. Rationale for dismissal: The recommendation for minimal use of prescribed fire would limit the ability of the U.S. Forest Service to implement forest restoration and resiliency treatments to shift the project area towards the desired conditions identified in the SFMLRP EA Chapter 1 because prescribed fire is a cost-effective tool that allows for treatment of larger areas when compared to the use of pile burning only. Similarly, given current vegetation conditions, the use of prescribed fire presents less risk as a management approach for the project area when compared to the use of managed wildland fire. Once vegetation conditions are changed, using wildland fire as a tool becomes more feasible. Recommended element: No thinning in IRA. Rationale for dismissal: Approximately 24,600 acres (49%) of the total SFMLRP area consist of IRAs. Therefore, the recommendation of vegetation thinning treatments outside of IRAs only would severely limit the ability of the forest restoration treatments to shift the project area towards the desired conditions identified in the SFMLRP EA Chapter 1. Based on the IRA review and analysis conducted for the SFMLRP Proposed Action, there would be little, if any, impacts to the nine roadless area values and characteristics identified for IRAs in the project area as defined in the 2001 Roadless Area Conservation Rule. Recommended elements: Identify IRA concerns and develop policy to restore. Reclamation of U.S. Forest Service roads deemed unessential in the SFNF's Travel Management Plan. Rationale for dismissal: The purpose of the SFMLRP is to improve the ecosystem resilience of a priority landscape to future disturbances by restoring forest structure and composition and reducing the risk of catastrophic wildfire. The recommended elements to a) identify IRA concerns and develop a policy to restore and b) reclaim roads deemed unessential would not meet the purpose and need the SFMLRP project. It is worth noting that the SFMLRP Proposed Action presented in EA Chapter 2 has been updated since public scoping, and it no longer includes road improvements or reclamation activities. Recommended element: Hand build structures in arroyos to slow flood waters Rationale for dismissal: The hand building of structures in arroyos is outside the scope of the SFMLRP and would not meet the purpose and need for the project, as described in SFMLRP Chapter 1. The proposed flood control structures in the Santa Fe Mountains could be considered under a different proposed project that has better-aligned goals and objectives.

Does not meet the purpose and need described in EA Ch. 1

Recommended element: Reintroduce beaver where appropriate

Rationale for dismissal: The reintroduction of beaver is outside the scope of the SFMLRP and would not meet the purpose and need for the project, as described in SFMLRP Chapter 1. The reintroduction of beaver in the Santa Fe Mountains could be considered under a different proposed project that has better-aligned goals and objectives. In addition, any proposed project involving the reintroduction of wildlife populations would need to be coordinated, and perhaps lead, by the New Mexico Department of Game and Fish because wildlife are managed by the State for the benefit of its citizens.

Recommended element: Increase law enforcement to protect against unsafe fire behavior.

Rationale for dismissal: Law enforcement to address unsafe fire behavior is an administrative action and does not require review under NEPA to implement. The SFNF implements measures to manage for unsafe fire behavior, such as closing the SFNF to the public when fire danger is high. These measures can be taken without being included in the SFMLRP Proposed Action or alternatives.

Alternative is outside the scope of the SFMLRP.

Recommended element: WUI program to support “fire proofing” and defensible space.

Rationale for dismissal: Developing a WUI program for completing mitigation activities on private lands is outside the jurisdiction of the U.S. Forest Service. However, the U.S. Forest Service is participating in the development of the Santa Fe County Community Wildfire Protection Plan and is a member of the Fireshed Coalition and supports such a program that could be fostered by these groups.

Recommended element: Develop alternative egress.

Rationale for dismissal: Developing alternative egress for NFS lands is an action for Travel Management Planning and is outside the scope of the SFMLRP EA.

Recommended element: Preserve community valued areas- Cougar Canyon

Rationale for dismissal: Cougar Canyon is outside of the SFMLRP area. Other specific areas valued by the community have not been identified through scoping comments.

2.4 Comparison of Alternatives

Table 2.9 summarizes the potential impacts to resources analyzed in Chapter 3 for the No Action Alternative and Proposed Action. For clarification and additional detailed discussion on how the impact analysis was conducted, the reader is referred to Chapter 3.

Table 2.9. Alternatives Comparison

Resource	No Action Alternative Alternative 1	Proposed Action Alternative 2
Vegetation Communities	Without implementing the treatments, forest conditions would continue to depart from desired conditions. The risk of fire with uncharacteristic fire severity and intensity would continue to increase within the project area. Forest structure would continue to transition into a homogenous state and would continue to be dominated by a single age class. Forests would lack the desired level of diversity in structure, species composition, and density. Forest susceptibility to insects and disease (e.g., bark beetles, defoliators, and mistletoe) would continue to increase.	Modeling of the Proposed Action shows long-term improvements relative to the No Action Alternative in all categories considered: BA, canopy cover, total flame length, crowning index, torching index, and canopy base height. The models also indicate the proposed treatments would successfully shift the current ratios of seral development (grass/forb/shrub, early-open, early-closed, late-open, late-closed) in the three target ERUs toward the desired future conditions.
Fire and Fuels	Without implementing the treatments, forest conditions would continue to depart from desired conditions and the existing conditions would persist, if not decline further. Fuel loading, particularly in the understory, would continue to increase, elevating the wildfire hazard of overstory woodland and forest species. The risk of fire with uncharacteristic fire severity and intensity would continue to increase within the project area. Modeling of very high wildfire behavior shows that most of the project area is currently at risk of sustaining high-intensity, widespread, damaging fire and the risk of fire with uncharacteristic fire severity and intensity would continue to increase within the project area.	Treatments would be effective in reducing wildfire behavior and integrated hazard and meeting desired conditions during the first few years after treatments are completed. Wildfire behavior and integrated hazard would be lowest in units treated with heavy thinning/piles burned and underburned.
Threatened and Endangered Species	There would be no noise or visual disturbance from proposed activities or any reduction in habitat components. The vegetation trends previously described would continue to cause a decline in the quality of mature, mixed conifer forest habitat for MSO.	Implementation of the Proposed Action has the potential to result in short-term adverse impacts to MSO. Adverse impacts are expected to be minimal and insignificant in comparison to stand-replacing wildfire. Additionally, the Proposed Action would result in long-term beneficial impacts to MSO by increasing acres of habitat which meet the USFWS 2012 MSO Recovery Plan and 2022 SFNF LMP desired conditions.
Flora and Fauna	There would be no temporary reduction of habitat as no treatments would occur. The vegetation trends previously described would continue to cause decline in the quality and quantity of habitat for all species analyzed.	Implementation of the Proposed Action has the potential to result in short-term adverse impacts to various species. Adverse impacts are expected to be minimal and insignificant in comparison to stand-replacing wildfire. Additionally, the Proposed Action would result in long-term beneficial impacts to species habitat by increasing acres of habitat which exhibit increased understory development and conditions for general wildlife species, migratory birds and bald and golden eagles.
Watersheds and Hydrology	Declines in soil productivity would occur as vegetation moves away from desired conditions. Without widespread groundcover, watersheds receiving intense precipitation (e.g., monsoon rains) are less able to absorb water, which would result in increased flood events. The increased risk of high-severity wildfire further threatens water quality from super-heated soil which would result in alteration of water's physical properties resulting in decreased infiltration and increased overland flow in addition to altering chemical processes from the use of human-made chemicals.	Implementation of the Proposed Action has the potential to result in short- and long-term adverse impacts to watershed resources (soil, water quality, and flow regimes). Adverse impacts to watershed resources are expected to be minimal, short term, and insignificant when compared with those by high-intensity wildfire.

Resource	No Action Alternative Alternative 1	Proposed Action Alternative 2
Riparian Resources	There would be no riparian vegetation treatments or other forest treatments. Increased abundance of evergreen trees in riparian areas and the surrounding upland forest would increase the risk of high-severity fire in the riparian which, in turn, would predispose these areas to invasive vegetation and woody exotic species.	The proposed treatments would address conifer encroachment and excessive vegetation density in riparian areas within the project area, reducing the risk of high-severity fire and subsequent vulnerability to encroachment of non-native vegetation within riparian habitats. Additionally, the proposed treatments would reduce the overabundance of late seral conditions, restoring ecological integrity of riparian habitat within the project area.
Air Quality and Climate	Smoke impacts could cause health issues during wildfire events, which have an unknown duration and location. Compromised visibility during wildfire events; potential adverse impacts to Class I areas.	Prior to implementing a prescribed fire, a prescribed fire plan would be written to follow the New Mexico Smoke Management Program and NWCG guidelines. The reduction in wildfire risk and potential smoke emissions would likely result in a long-term benefit to visibility conditions. Treatments would increase the resiliency and sustainability of carbon sequestration to future disturbances and the effects of climate change.
Recreation	No short-term adverse impacts would occur to recreation. Recreation would continue as it has in the past.	Short term, recreation activities might be temporarily restricted or degraded in quality in some areas for short periods of time due to prescribed burns, smoke, noise, fencing, or vegetative removal. Long term, recreation opportunities would not be impacted.
Scenery	The most noticeable changes to scenic conditions across the landscape would occur through natural processes such as wildfires, wind events, or flooding. These natural disturbances will continue to shape the vegetation and landform features of the landscape, affecting the overall sustainability of the scenic character.	It is anticipated that with the application of design features and based on professional judgement that the scenic character in the project area will be maintained and enhanced in the long term. The beneficial effects described above would occur throughout the project area resulting in long-term scenic quality and scenic character resilience.
Heritage Resources	The current conditions of the SFMLRP analysis area would remain the same in the immediate future. Archaeological sites would continue to be exposed to the customary and natural threats, such as weathering, erosion, and high-intensity wildfire. The increased risk of wildfires could lead to increased damage to fire-sensitive archaeological sites exposed to the sustained, intense heat from wildfires.	The analysis area contains 80 previously documented archaeological sites: 41 sites considered eligible, 25 undetermined until further testing, and 13 determined not eligible. All listed, eligible, and unevaluated sites would be flagged and avoided by mechanical treatments. Given the nature of potential effects and the use of standard mitigation measures, the Proposed Action would have no adverse effects on cultural resources.
Tribal and Traditional Uses	Without the landscape-scale treatments, TCPs, sacred sites, and traditional use areas within the project area would continue to be at risk of experiencing an uncharacteristically severe wildfire. In addition to this continued risk, an indirect long-term effect would be the continued accumulation of fuel in culturally sensitive areas, including fire-sensitive traditionally used resources.	Both initial project scoping for the project area and the ethnographic assessment conducted in the Fireshed reveal that tribes and traditional communities affiliated with the project area support U.S. Forest Service ambitions to reduce the risk of catastrophic wildfire and improve forest health. The U.S. Forest Service is committed to additional consultation efforts and involving tribes in details of project planning and implementation moving forward. Strengthening these partnerships via collaboration and facilitating active participation in project development is a goal of the Forest Plan as well as of federal guidance concerning tribal relationships.

Resource	No Action Alternative Alternative 1	Proposed Action Alternative 2
Range Resources	The No Action Alternative would have the least benefit to rangeland resources and ecosystem resilience because only small-scale, fragmented projects would be implemented across the landscape. Herbaceous vegetation and available livestock forage would continue to decline in areas that are not treated. There would continue to be periodic reductions in authorized livestock numbers or season of use, or a combination of both due to localized treatments.	Under the Proposed Action, range condition is expected to improve over the long term as forage production and quality increases, utilization rates decrease, and distribution of livestock improves. The long-term benefits would outweigh the short-term effects and would ultimately improve the ecological sustainability of livestock grazing, and substantially increase ecosystem resilience to uncharacteristically severe wildfire and other disturbances. Effects would be short term and would not result in permanent changes to permitted livestock numbers or season of use.
Inventoried Roadless Areas (IRAs)	No impacts to roadless character within IRAs.	No new roads would be constructed within the IRA to support the proposed treatments. There would be no change in the roadless character. While some short-term adverse impacts may occur, they are generally outweighed by the long-term benefits of the Proposed Action, including the reduced risk for high-severity wildfire. The adverse impacts would occur on less than 16% of the total IRA acreage within the project area and would generally be mitigated by the design features developed for the project. This project is also expected to reduce risks of high-severity, stand-replacing wildfires; thereby resulting in long-term beneficial impacts across all 24,613 acres of IRA within the SFMLRP area.

Chapter 3. Affected Environment and Environmental Consequences

3.1 Introduction

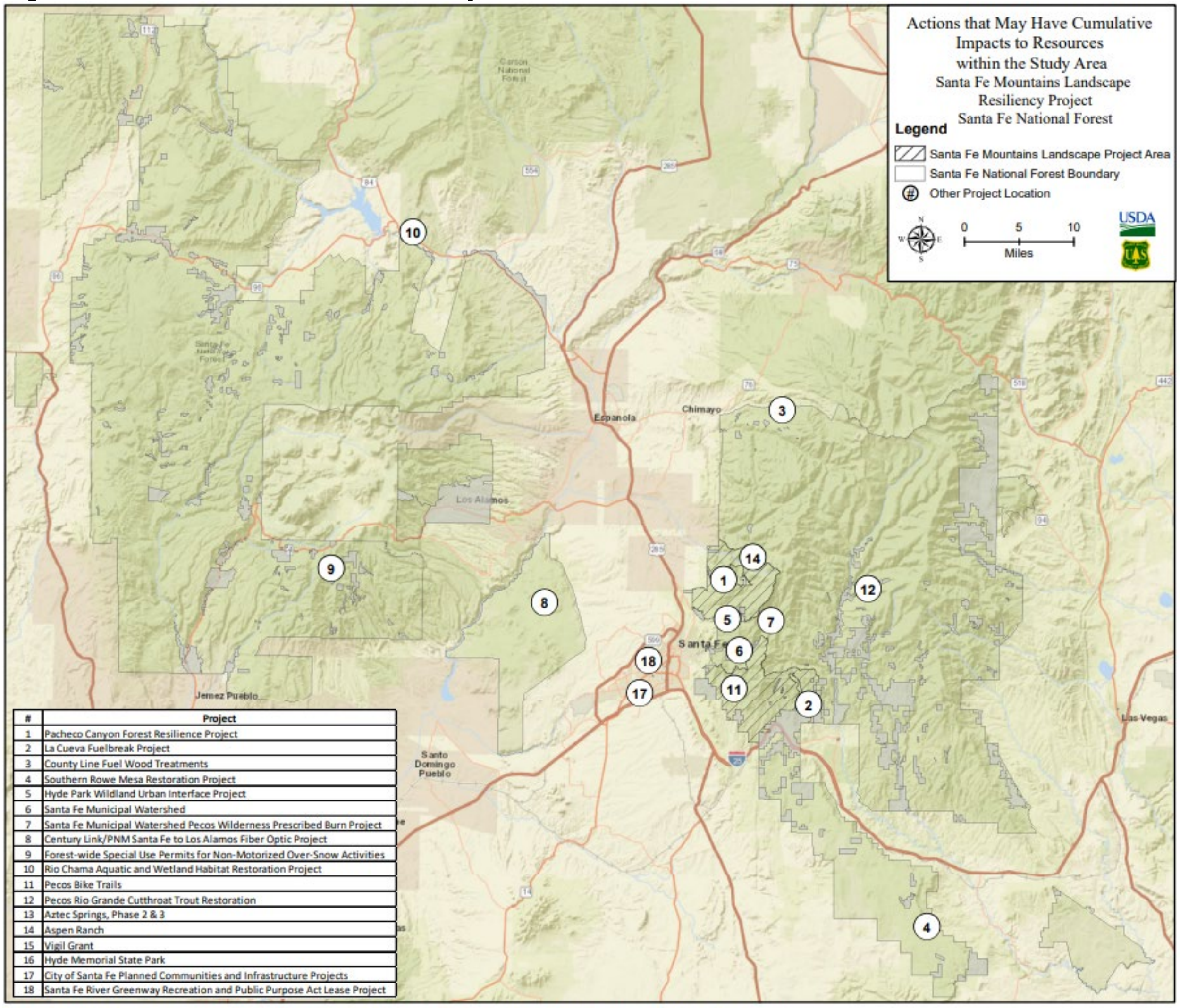
This section summarizes the physical, biological, social, and economic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. Complete U.S. Forest Service specialist reports for the project area are available in the project record.

3.1.1 Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

A cumulative impact or effect is a project-induced impact that, when added to the effects of other past, present, and reasonably foreseeable future actions, results in an incremental effect on the resource. Individually minor actions can become collectively more significant as they take place over a longer period of time. Cumulative effects are discussed in terms of changes in the existing condition due to present and foreseeable activities, including the effects of the alternative being discussed. The spatial context being considered for cumulative effects differs by resource area, as explained in the individual cumulative effects sections.

The actions listed in Table 3.1 are the present and reasonably foreseeable future actions that are included in the cumulative impact analysis area for each affected resource identified in Chapter 3. The cumulative effects of past actions are accounted for in the description of the affected environment presented for each resource in Chapter 3; therefore, no past projects are included in Table 3.1. For the purpose of this analysis, "reasonably foreseeable" actions are considered where there is a Proposed Action or existing decision (e.g., draft NEPA document, Record of Decision, or issued permit), a commitment of resources or funding, or a formal proposal (e.g., a permit request). Actions that are highly probable based on known opportunities or trends (e.g., residential development in urban areas) are also considered. Speculative future developments (such as those that are not formally proposed or do not have sufficient project details to inform analysis) are not considered. Present and reasonably foreseeable future actions were identified by the Española and Pecos-Las Vegas Ranger Districts and by using a list of proposed projects for the Española and Pecos-Las Vegas Ranger Districts available on the SFNF website (https://www.fs.usda.gov/projects/santafe/landmanagement/projects). Figure 3.1 and Table 3.1 summarizes the projects analyzed for cumulative effects in the resource sections below.

Figure 3.1. Location of Actions that may have Cumulative Effects



The data used to create this map is intended for broad-scale planning purposes. The Forest Service provides no warranty regarding its accuracy or use for other purposes.
T:\FS\NFS\SantaFe\Project\Espanola\SantefeFireShed\GIS\SFML\MXD\SFML_OtherProjectCumuEffect_Page.mxd, 11/29/2022

Table 3.1. Actions that May Have Cumulative Impacts to Resources Analyzed in this EA

Action	Summary of Action
Pacheco Canyon Forest Resilience Project	The scope of the project is to thin and use prescribed fire on approximately 2,042 acres northeast of the city of Santa Fe, near several popular recreation sites, including the Big Tesuque Campground, Aspen Vista Picnic Area, and the Santa Fe Ski Basin. Tesuque Pueblo lands are within and northeast of the project area. The purpose of the project is to change stand conditions in predominantly ponderosa pine forests in the Pacheco Canyon area. The actions proposed to accomplish this change would be thinning and burning about 2,042 acres. Decision signed on June 1, 2018.
La Cueva Fuelbreak Project	The purpose of the project is to change fire behavior in treated areas to reduce the risk of a large-scale, high-intensity wildfire spreading to or from the communities of La Cueva, Dalton Canyon, and the Santa Fe Watershed. This project proposes creation of a shaded fuelbreak by thinning 995 acres and conducting prescribed burns (pile and broadcast burning) on approximately 1,100 acres. Decision signed on February 4, 2005.

Action	Summary of Action
County Line Fuel Wood Treatments	The purpose of the project is to improve forest health and wildlife habitat through a combination of thinning and prescribed burning across approximately 900 acres on Borrego Mesa. Decision signed on August 6, 2010.
Southern Rowe Mesa Restoration Project	The purpose of this project is to promote a mosaic of healthy forest stands and natural grasslands through thinning and prescribed burning activities on approximately 17,500 acres on Rowe Mesa. Decision signed on February 21, 2013.
Hyde Park Wildland Urban Interface Project	The scope of the project is to thin and use prescribed fire on up to 1,840 acres. The project area is dominated by dense stands of ponderosa pine forests with a lesser component of mixed conifer and pinyon-juniper. The project area is located in forests east of the community of Hyde Park Estates, near Hyde Memorial State Park, and adjacent to Black Canyon campground. The purpose of this project is to reduce the risk of uncharacteristic, stand-replacing wildfire and reduce the risk for insect- and disease-related tree mortality within the project area. Decision signed on March 21, 2018.
Santa Fe Municipal Watershed	The scope of the project is to use a combination of tree thinning and prescribed burning on up to 7,270 acres of national forest and city lands in the Santa Fe Municipal Watershed. The proposal is designed to reduce the risk of a severe crown fire and to restore sustainable forest and watershed conditions in the Watershed. Record of Decision signed in October 2001.
Santa Fe Municipal Watershed Pecos Wilderness Prescribed Burn Project	The project proposes to perform prescribed burns of between 200 and 2,100 acres at one time in ponderosa pine and mixed-conifer stands within an approximately 2,900-acre, mid-elevation (8,500–10,000-foot) treatment area within the Pecos Wilderness. Decision signed on April 28, 2015.
Century Link/PNM Santa Fe to Los Alamos Fiber Optic Project (U.S. Forest Service n.d.)	Proposal to bury a fiber optic line along Forest Road 24 on SFNF land to a PNM transmission line where it would be carried to DOE facilities to improve service to Los Alamos National Lab and Los Alamos community. Notice of initiation October 1, 2018.
Issuance of Forest-wide Temporary and Priority Special Use Permits (SUPs) for Non-Motorized Over-Snow Activities (U.S. Forest Service n.d.)	Proposal to approve issuance of temporary and priority SUPs for outfitter and guides throughout the Santa Fe National Forest to conduct guided recreation activities related to over-snow uses, including but not limited to cross country skiing and snow shoeing. Notice of initiation December 1, 2019.
Rio Chama Aquatic and Wetland Habitat Restoration Project (U.S. Forest Service n.d.)	Species habitat improvement project to increase diversity and quality of aquatic habitat for fish and invertebrates in Rio Chama downstream from Abiquiu Dam approximately 5.6 miles between Santa Fe and Carson National Forests to point 1.34 miles upstream of the Highway 84 bridge. Notice of initiation October 1, 2019; implementation April 2020.
Pecos Bike Trails (U.S. Forest Service n.d.)	Project to develop trail system and impress access and promote visitor safety in the Canada de Los Alamos/Glorieta area. Notice of initiation November 1, 2019; expected implementation October 2020.
Pecos Rio Grande Cutthroat Trout Restoration (U.S. Forest Service n.d.)	Project to restore Rio Grande Cutthroat Trout populations to Willow Creek and upper Cow Creek by adding 9 miles of stream to currently occupied distribution. Scoping occurred February 2019.
Aztec Springs, Phase 2 & 3 (City of Santa Fe, The Nature Conservancy, New Mexico State Forestry)	150 acres of thinning, piling, and prescribed burning activities.
Aspen Ranch (Pueblo of Tesuque)	160 acres of thinning, piling, and prescribed burning activities in ponderosa pine and mixed conifer.
Vigil Grant (Pueblo of Tesuque)	158 acres of thinning, piling, and prescribed burning activities in ponderosa pine and mixed conifer.
Hyde Memorial State Park (New Mexico State Forestry)	Thinning, piling, and prescribed burning across 276 acres in Hyde Memorial State Park.

Action	Summary of Action
City of Santa Fe Planned Communities and Infrastructure Projects	Three master planned communities that are projected to absorb most of Santa Fe's growth through 2030 • Tierra Contenta Master Plan (1995) approved as many as 5,200 housing units and to date is 50% completed with up to 2,500 homes and apartment units completed. The western portion of Phase 2 and Phase 3 await construction and includes 400 acres of developable land and 100 acres of open space/parks. • Las Soleras Master Plan (2008) covers 400 acres with most of the land along I-25 slated for commercial and mixed use. Internal portion of master plan is reserved for residential units, which could be developed with 1,000 to 1,500 housing units. • Northwest Quadrant (2010) covers approximately 160 acres of 2,000 acres the City owns in the northwest corner of the city. The master plan calls for 750 housing units to the southeast of New Mexico Highway 599. Roadway improvements, trails, and urban mixed use and parks (Southwest Activity Node, Las Soleras Park, and South Meadows Park) (City of Santa Fe 2017). Multiple drainage projects are proposed by City of Santa Fe in Council Districts 1, 2, 3, and 4 to be completed in three phases between 2019 and 2022 (City of Santa Fe n.d.).
Santa Fe River Greenway Recreation and Public Purpose Act (R&PP) Lease Project	EA (released November 21, 2019) for the conveyance of 23.5 acres of Bureau of Land Management (BLM)-administered public land to Santa Fe County under the R&PP for the construction and maintenance of a short segment of the greenway and for bank stabilization of the Santa Fe River. The proposed project would create a greenway of public parks and multi-use recreational trails along the Santa Fe River from Two-mile Reservoir in eastern Santa Fe west to the Santa Fe County wastewater treatment plant, which is located just west of New Mexico Highway 599 (BLM 2019a).

3.2 Vegetation Communities

The focus of this section is to analyze the following questions:

- How would the proposed treatments address silvicultural concerns?
    - Promote the restoration of species composition, structure, and spatial pattern;
    - Establish conditions where fire can be a part of frequent fire systems;
    - Reduce the of risk of large, high-intensity fires; and
    - Establish a diversity of seral stages.
- How would the proposed treatments address forest health?
    - Manage the impacts of dwarf mistletoe;
    - Slash management to mitigate the impacts of bark beetles (*Ips* spp.);
    - Reduce the risk of bark beetle outbreaks; and
    - Manage the impacts of Douglas-fir tussock moth.
- How would the proposed treatments affect upland vegetation?
    - Manage and preserve southwestern white pine;
    - Retain and promote large and old trees;
    - Effects of canopy cover reduction;
    - Develop snag retention strategy.
- How would the proposed treatments affect old growth?
    - Retention and culturing of old growth conditions;
    - Implementation of a large tree retention strategy.
- How would Forest Plan affect At-Risk Species and SCC wildlife habitat?

- Treatment of vegetation related to MSO PACs;
- Adoption of aspects of the revised 2012 MSO recovery plan;
- Clarification of activity restrictions during MSO breeding seasons;
- Clarification of need for Northern goshawk interspaces.

3.2.1 Affected Environment

Although the project area is approximately 50,500 acres in size and covers a variety of ERUs as detailed in Table 1.1, Section 1.3, and Figure 1.4, silvicultural and fuels management are proposed to take place only within the mixed conifer-frequent fire forest, ponderosa pine forest, and pinyon-juniper woodland/grassland ERUs (see Table 2.3). Based on the focus of treatment within these ERUs, the analysis below examines the mixed conifer-frequent fire, ponderosa pine, and pinyon-juniper ERUs.

Mixed Conifer-Frequent Fire

This community, also known as "dry mixed conifer" is generally found at an elevational range of 6,000 to 9,500 feet within the project area. Ponderosa pine, quaking aspen, southwestern white pine, and Gambel oak are generally dominant. Other co-dominant to common species include Douglas-fir, white fir, and blue spruce (*Picea pungens*) (USDA 2022a). Typical natural fire regimes include frequent (2–24 years) low-severity fire (USDA 2014).

Within the project area, the mixed conifer frequent fire forests depart from desired conditions on two primary characteristics: density and size. More specifically, stands of the mixed conifer frequent fire type are denser and more overstocked (80% of the "closed" state compared with 28% as desired). Additionally, a much larger component of this ERU is dominated by smaller trees as opposed to larger trees; nearly half of the ERU is classified as being of the mid-closed seral stage, and the desired representation of this stage is very minor (3%) (Table 3.2 and Figure 3.2).

Table 3.2. Desired Mixed Conifer–Frequent Fire Conditions

Seral Stage	Desired (%)	Existing (%)	Tree Diameter (inches)	Cover (%)	Structure
Grass, Forb, Shrub- Early	9	1	0–4.9	All	All
Mid-Open	3	0	5–9.9	10–30	All
Mid-Closed	3	47	5–9.9	>30	All
Late-Open	60	7	>10	10–30	Uneven-age
Late-Closed	25	45	>10	>30	All

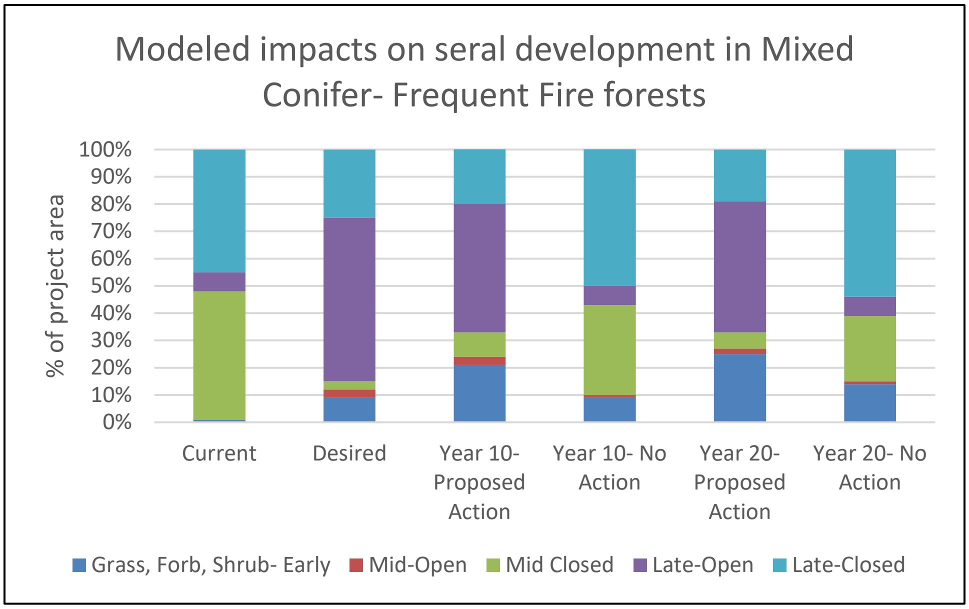


Figure 3.2. Modeled seral development in mixed conifer-frequent fire forests.

Ponderosa Pine Forests

Within the project area, two sub-classes of the ponderosa pine ERU are found: ponderosa pine bunchgrass and ponderosa pine Gambel oak. These subgroups are analyzed as a single ERU within this EA.
This community is generally found at elevations of 5,000 to 9,000 feet. Tree vegetation is dominated by ponderosa pine, but also includes various oaks (*Quercus* sp.), juniper (*Juniperus* sp.), two needle pinyon, quaking aspen, Douglas-fir, white fir, and blue spruce (USDA 2022a). Natural fire regimes consist of frequent (2–24 years) low-severity fire (USDA 2014).

Within the project area, the ponderosa pine ERU deviates from desired conditions, primarily on two basic conditions: cover and dominant tree size. In general, the stands that compose the ERU are overstocked. Desired conditions are such that the total area of mid and late seral stage with canopy cover in excess of 30% is minor, however, under current conditions mid and late seral stage closed canopy is predominant in terms of the percentage of total ERU area. Additionally, areas dominated by smaller trees are overly abundant compared with desired conditions; that is, this ERU is dominated by smaller trees (5–9.9 inches dbh) compared with the relatively minor amounts of the desired conditions (Table 3.3 and Figure 3.3).

Table 3.3. Desired Conditions Ponderosa Pine Forests

Seral Stage	Desired (%)	Existing (%)	Tree Diameter (inches)	Cover (%)	Structure
Grass, Forb, Shrub- Early	2	13	0–4.9	All	All
Mid-Open	2	1	5–9.9	10–30	All
Mid-Closed	2	41	5–9.9	>30	All
Late-Open	82	7	>10	10–30	Uneven-age
Late-Closed	12	39	>10	>30	All

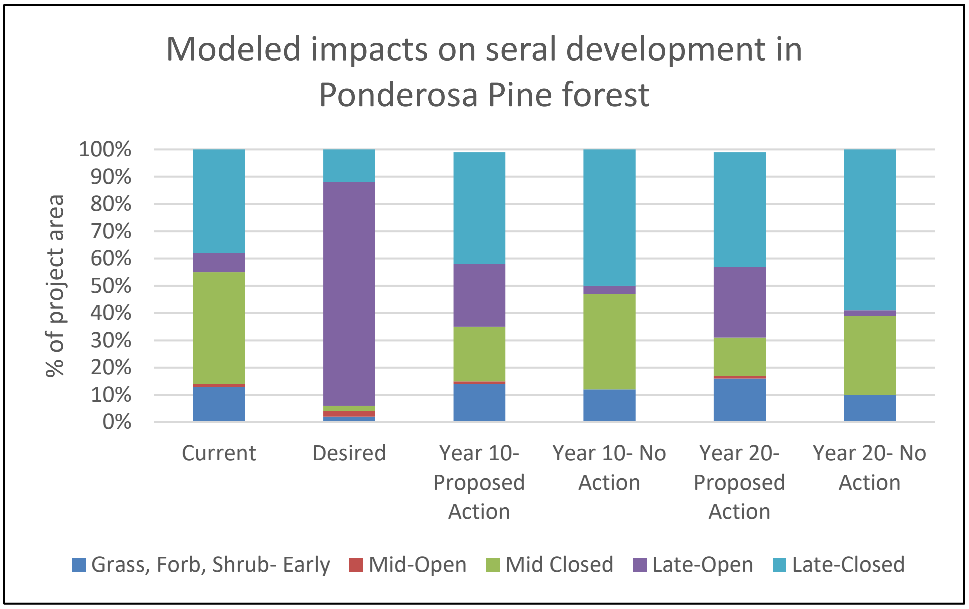


Figure 3.3. Modeled seral development in ponderosa pine forest.

Pinyon-Juniper Woodlands and Grasslands

Tree species of this group predominantly includes two needle pinyon, one seed juniper, and alligator juniper. Other juniper species, such as Utah juniper and Rocky Mountain juniper, may be present (USDA 2022a). Grassland fire regimes are typically frequent (0–35 years) and low severity, while woodland and sagebrush fire regimes vary from infrequent (35–200 years) moderate severity to infrequent (>200 years) high-severity fires (USDA 2014).

Within the project area, both the pinyon-juniper grassland/juniper grassland ERU and the pinyon-juniper woodland ERU have the same issue with respect to deviation from desired conditions. That is, the "early-closed" seral stage is overabundant within the ERU. Additionally, within the grassland types, there is an absence of areas with low/open canopy cover and as well as areas dominated by large trees (Table 3.4 and Figure 3.4). Within the woodland type, there is an underrepresentation of areas dominated by large trees (Table 3.5 and Figure 3.5).

As related to this project, the pinyon-juniper woodland ERU will not be treated with the objective of meeting or moving toward the desired conditions identified by the region. This ERU would be treated to meet objectives related to fire, fuels, and WUI. The purpose and need states, "reduce the risk for large high-intensity wildfires, create safe, defensible zones for firefighters and minimize the risk of fire to nearby valued resources." The desired condition within this ERU is the reduction of fuel (surface, ladder, and canopy) loading and extreme fire risk. However, seral state data would be presented as part of this EA for this ERU in order to express the anticipated changes within this ERU over time, for both the No Action and Proposed Action Alternatives.

Table 3.4. Desired Pinyon-Juniper Grassland and Juniper Grassland Conditions

Seral Stage	Desired (%)	Existing (%)	Tree Diameter (inches)	Cover (%)
Grass, Forb, Shrub	5	0	N/A	<10
Early-Open	25	2	0–9.9	10–30
Early-Closed	10	94	5–9.9	>30
Late-Open	50	0	>10	10–30
Late-Closed	10	3	>10	>30

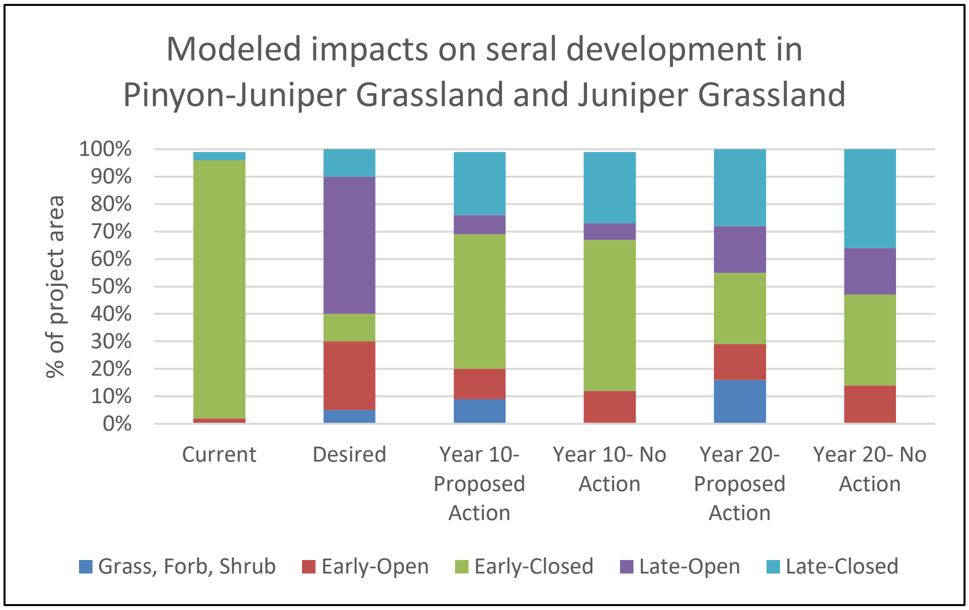


Figure 3.4. Modeled seral development in pinyon-juniper grassland and juniper grassland.

Table 3.5. Desired Pinyon-Juniper Woodlands Conditions

Seral Stage	Desired (%)	Existing (%)	Tree Diameter (inches)	Cover (%)
Grass, Forb, Shrub	10	0	N/A	<10
Early-Open	5	1	0–9.9	10–30
Early-Closed	15	85	5–9.9	>30
Late-Open	10	1	>10	10–30
Late-Closed	60	13	>10	>30

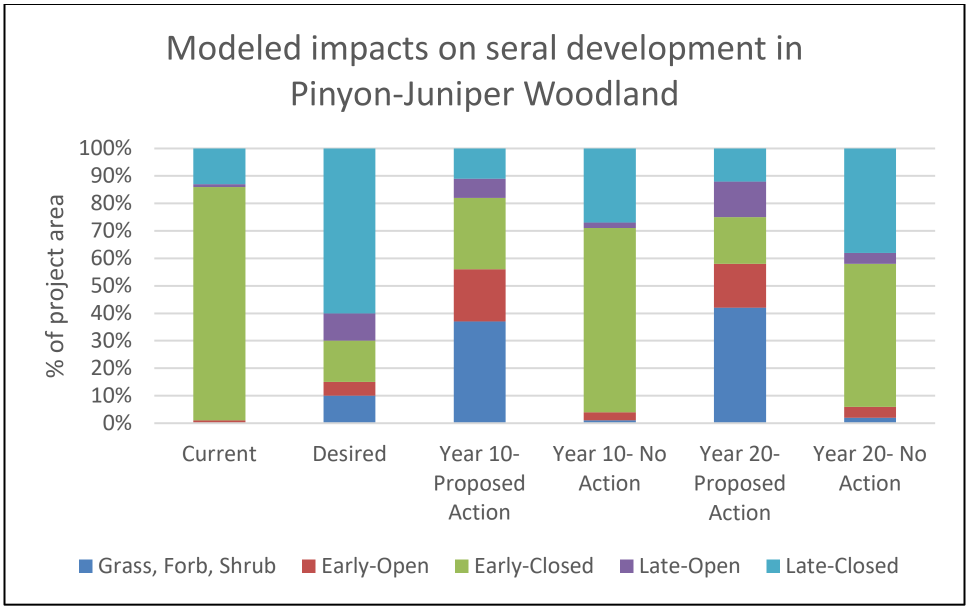


Figure 3.5. Modeled seral development in pinyon-juniper woodland.

Forest Health

A number of insects, parasites, and pathogens are impacting the montane forests of the Southwest, including native species of bark beetles (Scolytidae and *Dendroctonus*), defoliating insects, dwarf mistletoes (*Arceuthobium*), and root decay fungi (Dahms and Geils 1997). Some outbreaks if persistent reduce tree vigor and can cause mortality. The following summarizes the insects, parasites, and pathogens of concern for the SFMLRP include:

Douglas-fir beetle: Douglas-fir beetle (*Dendroctonus pseudotsugae*) is common through the project area. Douglas-fir beetle is host specific to the Douglas-fir tree. Stands that are generally more susceptible are dense, more moist sites, older (>120 years), with root disease present, and with injuries common (Kegley 2011).

Fir engraver: The primary hosts for the fir engraver (*Scolytus ventralis*) include white fir but may also infest Douglas-fir and subalpine fir. Fir engraver generally causes top kill and dead branches. Mortality is generally induced when infestation occurs in addition to other effects; such as root disease, drought, or defoliation (Randall 2012).

Pine engraver (*Ips pini*) affects ponderosa pine and generally is found in logging slash, damaged or dead trees (tops), and in small diameter (sapling/pole) sized trees. Outbreaks can occur after disturbance events which may include harvest operations, drought, and windthrow (Livingston 2010).

Western pine beetle (*Dendroctonus brevicomis*) attacks typically occur in ponderosa pine and often reaches outbreak conditions within periods of drought or following fires. The ponderosa pine trees most susceptible to western pine beetle attack are older, with poor crown ratios and slow growth. Stands most susceptible to western pine beetle outbreak are overstocked with larger trees and of a more simple structure (Randall 2010a).

Douglas-fir tussock moth (*Orgyia pseudotsugata*) can effect Douglas-fir, true fir, and spruce. The larvae are the defoliation agent and have the potential to cause top kill, mortality, and to increase susceptibility to bark beetle attack. Outbreaks are generally cyclical and happen every 8 to 12 years (USDA 2011).

Based on this cyclical period and because the previous outbreak was in 2018, another outbreak within the project area would be likely during the life of the project.

Janet's looper: In 2018, the Janet's looper (*Nepytia janetae*) caused defoliation damage on approximately 9,000 acres in the Santa Fe National Forest. These caterpillars can defoliate true fir, spruce, and pine trees, which can lead to tree stress and potentially tree mortality (Coleman 2018). Defoliation from Janet's looper has had an effect on mixed conifer and spruce-fir stands within the project area, but effects have peaked and are expected to subside.

Western spruce budworm: The host species for the western spruce budworm (*Choristoneura occidentalis*) include Douglas-fir, true fir, and spruce. The effects on the host include defoliation, top kill, deformities, mortality, and seed loss. Populations tend to be cyclical. Stand characteristics which tend to relate to pest impact and damage include multi-storied stands, higher portions of stocking in host species, and southern facing aspects (Pederson et al. 2011).

Dwarf mistletoe is very common parasitic plant infecting the ponderosa pine and Douglas-fir (*Arceuthobium vaginatum* subspecies *cryptopodum* and *Arceuthobium douglasii,* respectively) within the project area. Dwarf mistletoe infections alter tree form; diminish growth, vigor, seed production; increase susceptibility to other insects and disease; and can lead to top kill and mortality (Beatty and Mathiasen 2003; Hadfield et al. 2000). In addition to parasitizing trees, dwarf mistletoe also provides habitat (witches brooms and dwarf mistletoe snags) and food sources (mistletoe shoots) for many wildlife species within the project area. However, little to no evidence exists that any wildlife species is dependent upon dwarf mistletoe (Worrall 2015).

White pine blister rust (*Cronartium ribicola*) is an introduced fungal disease that can affect the southwestern white pine within the project area. The fungus can cause top kill or tree mortality by girdling the stem and can affect pine of any size. Management of natural white pine in mixed forest stands includes the retention of white pine for the purposes of maintaining genetic diversity and for retention of blister rust resistant stock (Schwandt et al. 2013).

Old Growth

The 2022 Forest Plan describes old growth characters (e.g., large and old trees, coarse woody debris, and snags) as embedded in mid to late seral stages of all ERUs. In Figures 3.1, 3.2, 3.3, and 3.4 the models describe an increase in mid to late seral stages across treated ERUs. Old growth characteristics within the landscape that currently meet or are likely to be able to meet desired conditions in the near future would be managed to retain those characteristics within the project area. Some areas managed for wildlife habitat, i.e., MSO nest/roost areas and replacement nest/roost areas as well as northern goshawk post-fledging areas (PFAs) and nest areas, provide opportunities to enhance old growth characteristics due to the desired structural and density characteristics of the habitat areas.

3.2.2 Environmental Consequences

Methods and Assumptions Used for Analysis

This analysis makes use of data derived from the Forest Vegetation Simulator (FVS), which utilizes Common Stand Exam (CSE) data, and a state and transition model, which utilizes spatial delineations of vegetation data. FVS is an individual tree growth and yield model that utilizes field-sampled data (CSE data), from forested and woodland stands from the project area and adjacent to the project area, and "grows" these trees (collectively as "stands") over a set period of time, with and without management activities. Data from these model runs were used to provide information related to reasonably anticipated trends of the Proposed Action and No Action Alternatives on the fine to mid-scale scope. FVS models were run through a 50-year planning horizon. The state and transition model uses space, time, change over time as a stochastic process, as well as rates of change to represent a vegetated landscape, in this case, and changes over time due to ecological processes.

DATA SOURCES

The FVS modeling utilized CSE data collected from the SFNF Española and Pecos-Las Vegas Ranger Districts collected from 2009 through 2019. A set of stands were selected for the predominant ERU and Seral States found within the project area. As many as 20 stands per seral state were selected; however, some less common seral states were more poorly represented in terms of stand data and substantially fewer stands were added to the modeling effort. The results of FVS modeling are not intended to represent specific stands or specific conditions; however, results are intended to represent anticipated trends of conditions based upon proposed management actions.

The state and transition model uses and projects spatial delineations of vegetation data over time. Spatial data utilized include ERUs, vegetation size class, canopy cover, and number of vegetation stories. ERU represents potential natural vegetation under natural disturbance events. These data were the Region 3 ERU GIS data (U.S. Forest Service 2021d). Vegetation size class, canopy cover, and vegetation stories were derived from the Region 3 Midscale Vegetation dataset. Data from FVS, Forest Health aerial detection surveys, and potential locations and parameters of potential treatments were also factored into this model. Similarly, to the FVS modeling, results of the state and transition modeling are intended to represent trends and not specific values or conditions.

Alternative 1: No Action Alternative

Under the No Action Alternative, current management plans would continue to guide the management of the project area. No prescribed burning, vegetation and restoration treatments, or road maintenance, would be implemented to accomplish project goals within the project area, unless approved through a separate NEPA document and decision. Without implementing the treatments, forest conditions would continue to depart from desired conditions. The risk of fire with uncharacteristic fire severity and intensity would continue to increase within the project area. Forest structure would continue to transition into a homogenous state and would continue to be dominated by a single age class. Forests would lack the desired level of diversity in structure, species composition, and density. Forest susceptibility to insects and disease (e.g., bark beetles, defoliators, and mistletoe) would continue to increase. Ultimately, the landscape would not be moved toward desired conditions, and as such, the No Action Alternative would not meet the purpose and need for the project.

Alternative 2: Proposed Action

The Proposed Action has two essential objectives: the reduction of fuel loadings, including surface, ladder, and canopy fuels; and the reestablishment of fire upon the landscape as a naturally occurring and desirable ecological process. Other vegetation-based objectives, such as ecological resilience, forest health, catastrophic wildfire risk reduction, and old growth promotion and retention, are to be met through the achievement of these primary two objectives. Under the Proposed Alternative, up to 38,000 acres would be treated by prescribed fire, and of those, up to 18,000 acres would be treated by thinning and/or mastication (Table 3.7).

Table 3.6. Proposed Area Treated by ERU

Ecological Response Unit	Acres within Project Area	Proposed Acres of Thinning or Mastication	Percentage Thinned or Masticated	Proposed Acres of Prescribed Fire	Percentage Burned
Mixed Conifer-Frequent Fire	17,875	7,500	42	17,000	95
Ponderosa Pine	17,347	6,500	37	17,000	98
Pinyon-Juniper Group	8,660	4,000	46	4,000	46

Identification of areas to be treated and specific methods to be utilized would be performed through conditions-based management. In essence, certain management actions are to be applied, on the ground, to stands that meet certain pre-defined conditions (Table 3.8–Table 3.10). Please note that not all of these conditions need to be met in order for treatment to occur and treatments may not occur in stands in which these conditions are met. This is intended to be a general guide to quantify the types of stand conditions where treatments would be necessary in order to improve stand conditions and to meet objectives identified by the Purpose and Need.

Table 3.7. Stand Conditions where Thinning Treatments May Be Considered

ERU	Basal Area* (square feet/acre)	Trees Per Acre*	Quadratic Mean Diameter*	Canopy Cover* (%)	Canopy Base Height* (feet)
Mixed Conifer- Frequent Fire	>70	>500	>6 inches dbh	>30	<8
Ponderosa Pine	>60	>500	>6 inches dbh	>30	<8
Pinyon-Juniper Types	>60	>400	>7 inches drc	>30	<4

*Stand conditions need not meet all above thresholds in order to be considered for treatment

Table 3.8. Potential Treatments for Mixed Conifer Frequent Fire and Ponderosa Pine ERUs

Seral Stage	Dominant Tree Size Class (inches)	Canopy Cover Class (%)	Potential Treatments
Grass, Forb, Shrub	0–4.9	Any	Thinning and/or Prescribed Fire
Mid-Open	5–9.9	10–29.9	Prescribed Fire
Mid-Closed	5–9.9	≥30	Thinning and/or Prescribed Fire
Late-Open	≥10	10–29.9	Prescribed Fire
Late-Closed	≥10	≥30	Thinning and/or Prescribed Fire

Table 3.9. Potential Treatments for Pinyon-Juniper Woodland and Grasslands and Juniper Grassland ERUs

Seral Stage	Dominant Tree Size Class (inches)	Canopy Cover Class	Potential Treatments
Grass, Forb, Shrub	N/A	<10%	Prescribed Fire
Early-Open	0–9.9	10–29.9	Prescribed Fire
Early-Closed	5–9.9	≥30	Thinning and/or Prescribed Fire
Late-Open	≥10	10–29.9	Prescribed Fire
Late-Closed	≥10	≥30	Thinning and/or Prescribed Fire

TREATMENT EFFECTS

Under the Proposed Action, thinning would be implemented as a precursor for the prescribed fire treatments, as necessary based upon stand conditions, in order to create conditions and fuel loadings that would allow for a more predictable and desirable post-fire condition. More specifically, prescribed fire would create conditions where fire can be more easily controlled and risk of high mortality would be minimized in areas where stand conditions are such that undesirable results are likely. Thinning and mastication treatments would remove ladder fuels and reduce canopy bulk density. Activity fuels, logs and limbs from thinned trees, would be piled (and burned when appropriate), lopped and scattered, or left in place (generally larger logs and masticated material). In addition to activity fuels, existing surface fuels may be piled (and burned), lopped and scattered, or masticated depending upon levels of existing surface fuels. Additionally, these treatments would utilize a species preference in order to target early seral, shade intolerant, and fire tolerant tree species for retention.

Following the necessary mechanical fuels treatments, prescribed fire would be applied with decreased risk of non-characteristic fire behavior (high-severity and high-intensity crown fire). Prescribed fire would include the burning of piles (as necessary), jackpot burning, and broadcast burning. These treatments are intended to remove fuel load, modify species composition, restore structural diversity, restore spatial pattern, and improve forest health. Fuel load removal is to be accomplished by way of combustion through the implementation of the various prescribed fire methods. The removal of fuels (surface, ladder, and canopy) by way of mastication, thinning, and prescribed fire would reduce the risk of uncharacteristic high intensity/severity fire within treated areas by removing the available fuel needed to carry the fire and to create high-intensity flames (Agee and Skinner 2005).

The restoration of species diversity is to be achieved by way of species preference within the thinning phase as well as targeted mortality of tree species not tolerant of fire within the prescribed fire phase of active management. Some tree species, such as white fir, which have thrived in the era of fire exclusion would be more prone to fire induced mortality due to physical characteristics, such as thin bark (Table 3.11). It can be expected that shade intolerant species would be, generally, more likely to regenerate in areas which are open or have been opened by active management activities, while shade intolerant species would be more likely to regenerate in areas which have retained closed canopies.

Table 3.10. Seral State, Shade Tolerance, and Fire Tolerance of Common Tree Species

Common Tree Species	Seral State	Shade Tolerance	Fire Tolerance
Colorado Blue Spruce	Early-Late	Intermediate	Intolerant
Corkbark Fir	Late	Tolerant	Intolerant
Douglas-fir	Early-Late	Intermediate	Tolerant
Engelmann Spruce	Early-Late	Tolerant	Intolerant
Limber Pine	Early-Late	Intolerant	Intermediate
One-seed Juniper	Early-Late	Intolerant	Tolerant
Two-needle Pinyon	Early-Late	Intolerant	Intermediate
Ponderosa Pine	Early-Late	Intolerant	Tolerant
Quaking Aspen	Early	Intolerant	Tolerant
Rocky Mountain Juniper	Early-Late	Intolerant	Intolerant
Southwestern White Pine	Early-Late	Intolerant	Tolerant
White Fir	Late	Tolerant	Intolerant

The restoration of both structural diversity and spatial pattern would be achieved over time through the restoration of fire upon the landscape as an ecological process, i.e., repeated application of low-intensity prescribed fire as well as natural fire which may or may not be managed in order to meet management objectives. With the application of prescribed fire, it is expected that there would be mortality. This mortality would largely affect small to medium sized trees of the understory and mid-story, but would also affect large trees and, occasionally patches or clumps of trees. The reduction of canopy cover, resulting from management activities is anticipated to have an effect on light intensity upon the forest floor, soil pH, soil depth, as well as litter depth and cover (Evenson et al. 1980). The creation of openings is critical for the establishment of shade intolerant regeneration, horizontal diversity (group/clump structure), and growth of herbaceous material. However, opening of the canopy may promote the growth and development of a shrub layer in the frequent fire forest types and woodlands. Follow-up prescribed burning, thinning, or other treatments may be required as adaptive management methods in order to mitigate this potential result.

Improvements in forest health is to be attained though thinning, mastication, and prescribed fire and maintained through the application of prescribed fire upon the frequent fire ecosystems of the project area. This includes density control as well as the effects on dwarf mistletoe. The reintroduction of frequent low-severity fire is anticipated to create and maintain density and species composition more in line with conditions prior to fire exclusion, i.e., lower overall stocking, an increase in the relative stocking of early seral species as compared to late seral species, as well as an increase in both horizontal and vertical diversity (more uneven-aged structure as well as clumpy spatial arrangement).

The decrease in stocking resulting from management activities is anticipated to reduce resource (water, nutrients, and light) competition among trees, which would allow for improved resistance and resiliency from the impacts of agents such as bark beetles and defoliators (Kegley 2011; Livingston 2010; Pederson et al. 2011; Randall 2010a, 2010b, 2012). For example, healthier trees are more able to defend themselves from bark beetles, and more able to bounce back from defoliation events. Opportunities for the establishment of regeneration would promote resilience by allowing for the growth and development of the next generation or cohort of trees within stands. Additionally, prescribed fire has been documented to reduce dwarf mistletoe within treated stands. Heavily infested trees are less likely to survive application of prescribed fire and lightly to moderately infected trees are likely to experience reduction of infection through the heat and flames of prescribed fire on lower limbs (Conklin and Geils 2008). However, prescribed fire may stimulate certain forest pests. High incidence of scorch and fire-induced mortality can stimulate Douglas-fir bark beetle (Kegley 2011) and western pine beetle (Randall 2010a). Fire effects may also provide excessive environmental stressors on trees affected by defoliation, which may increase effects such as top kill, die-back, and mortality. Design Features (Ips-1 and Ips-2 in Appendix C) have been incorporated into the proposed project to mitigate potential insect and disease issues resulting from treatments. These include the established slash management methods for management and monitoring for potential bark beetle infestation within burned areas, Ips-3 through Ips-5 (see Appendix C) and U.S. Forest Service Forest Health Protection will continue to monitor for bark beetle activity during annual aerial detection surveys.

The Proposed Action is not anticipated to have a substantial effect upon old growth or large trees within the project area. The Proposed Action includes a “diameter cap” of 16 inches dbh for “forest species” and 12 inches drc for “woodland species.” Given these limits, no large trees would be removed by thinning or mastication operations, unless safety warrants. However, there likely would be some impact from prescribed fire application. It is expected that these would be minor and any losses of large trees upon the landscape would likely be replaced by ingrowth from smaller trees over time. Other old growth and wildlife key habitat features (large down logs and snags) may be impacted by the Proposed Action and would have project design features (Wild-16 through Wild-20) in place to ensure that management actions do not reduce key habitat features below minimum thresholds (see Appendix C). Impacts on large down logs and snags from prescribed fire activities can be unpredictable; however, large logs and snags would be retained and not cut or targeted for ignition or piling (except where they pose a safety concern). Felled hazard trees or snags would remain on-site to contribute to large, downed woody debris habitat. If the desired number of snags per acre is not available for retention, snag creation would be considered, through methods such as girdling or through prescribed fire.

The effects of the Proposed Action on seral development (seral stages) have been modeled at landscape- and fine-/mid-scale, reflecting the current situation, desired conditions, and expected future conditions in 10-year increments (Figure 3.6 through Figure 3.9) and U.S. Forest Service 2020a:Tables 21–25 and Appendix A).

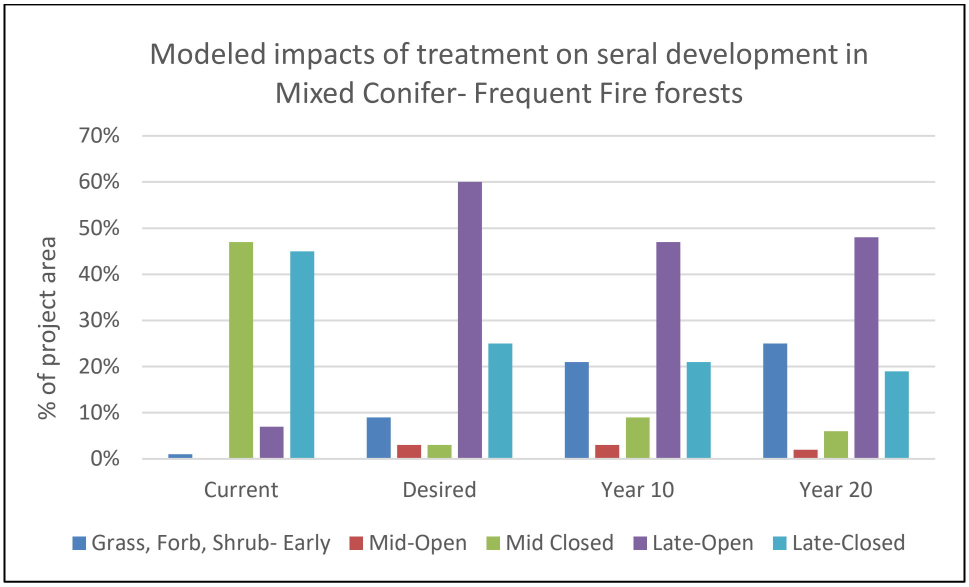


Figure 3.6. Modeled seral development in the mixed conifer-frequent fire ERU under the Proposed Action.

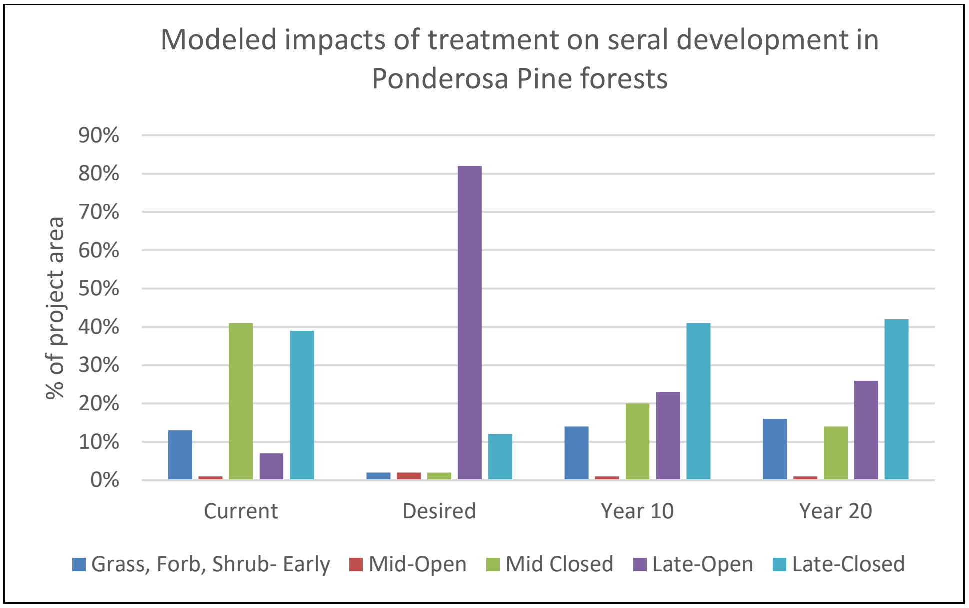


Figure 3.7. Modeled seral development in the ponderosa pine ERU under the Proposed Action.

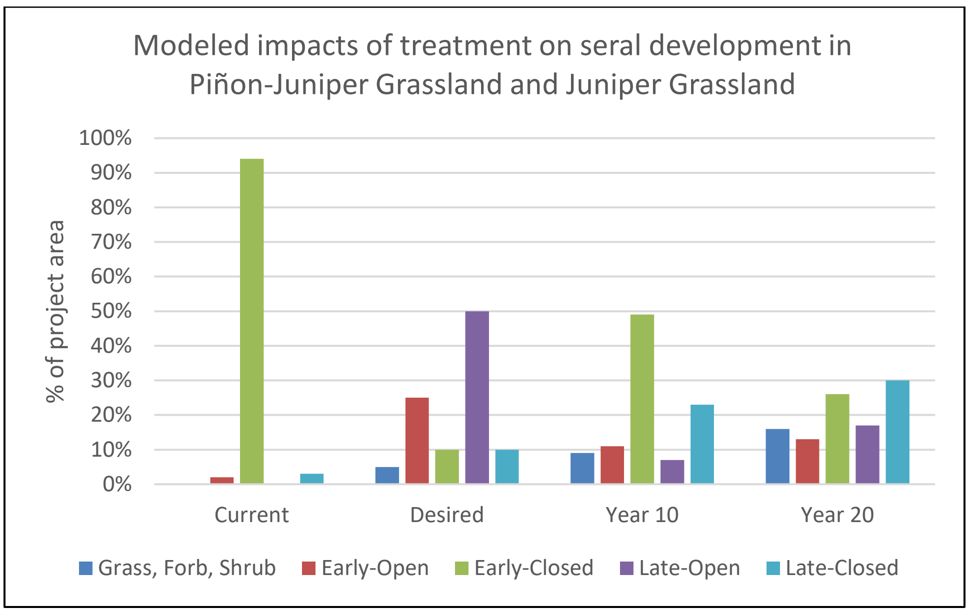


Figure 3.8. Modeled seral development in the pinyon-juniper grassland and juniper grassland ERU under the Proposed Action.

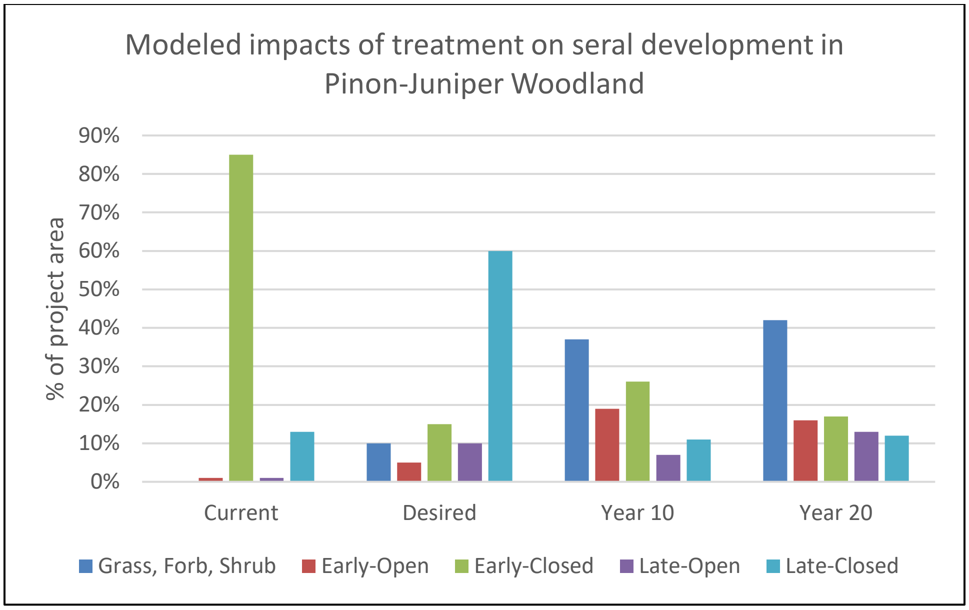


Figure 3.9. Modeled seral development in the pinyon-juniper woodland ERU under the Proposed Action.

Relative to the No Action, the models show long-term improvements in all categories considered: BA, canopy cover, total flame length, crowning index, torching index, and canopy base height. The models also indicate the proposed treatments would successfully shift the current ratios of seral development (grass/forb/shrub, early-open, early-closed, late-open, late-closed) in the three target ERU toward the desired future conditions Table 3.12 (U.S. Forest Service 2020a).

Table 3.11. Anticipated Impacts from Proposed Treatments Relative to the No Action Alternative

Ecological Response Unit	Seral State	Basal Area*	Canopy Cover*	Total Flame Length*	Crowning Index*	Torching Index*	Canopy Base Height*
Mixed Conifer-Frequent Fire	Mid-Closed	↓	↓	↓	↑	↑	↑
	Late-Open	-	-	-	↑	↑	↑
	Late-Closed	↓	↓	↓	↑	↑	↑
Ponderosa Pine Forest	Mid-Closed	↓	↓	↓	↑	↑	↑
	Late-Open	-	-	-	↑	↑	↑
	Late-Closed	↓	↓	↓	↑	↑	↑
Pinyon-Juniper	Early-Open	↓	↓	↓	↑	↑	↑
	Early-Closed	↓	↓	↓	↑	↑	↑
	Late-Closed	↓	↓	↓	↑	↑	↑

* Key: Decrease (↓),Increase (↑), No Substantial Change (-)

Overall, the Proposed Action, as designed, would either produce the desired vegetation-based conditions or move conditions toward meeting desired vegetation-based conditions. The proposed treatments would allow for the safe application of prescribed fire, reduce the risk of catastrophic wildfire in historically frequent fire ecosystems, improve forest health by reestablishing diversity and reduction of tree-to-tree resource competition; and restore more diversity in terms of species composition, seral states, and spatial distribution within the frequent fire ecosystems of the project area.

Cumulative Effects

See Table 3.1 for a list of present and reasonably foreseeable future actions considered for cumulative effects on vegetation communities. Spatial and temporal boundaries for cumulative impacts analysis are the same as described above.

Ongoing and planned fuel reduction projects would continue to occur on adjacent tribal lands and other federal, state, and private lands surrounding the project area. Restoration activities would occur on adjacent public lands, including, but not limited to, the Aztec Springs (Phases 2 and 3), Aspen Ranch, Vigil Grant, Hyde Memorial State Park, and Santa Fe Municipal Watershed projects. These activities would also increase ecosystem resilience in the analysis area. Combined, these projects would treat up to approximately 34,000 acres over the next decade. These would have cumulative short-term adverse and long-term beneficial impacts on vegetation communities. Short-term adverse impacts include temporary, localized removal or disturbance of vegetation as a result of vegetation thinning treatments, prescribed fire, and potential for indirect adverse impacts, including temporary damage to soil substrates that impact growing conditions and increased vulnerability to nonnative species resulting from disturbance. Short-term adverse impacts include temporary, localized removal or disturbance of vegetation as a result of vegetation thinning and prescribed fire treatments. Mechanical treatments and other restoration activities on the adjacent state lands and tribal lands would further increase long-term forest health.

Forest restoration and resiliency treatments are designed to move vegetation communities toward desired conditions, so most impacts to vegetation communities would be considered beneficial both in the short and long term. Restoration treatments improve species composition, increase stand heterogeneity both in terms of structure and age distribution, and improve forest health and resilience to insect, disease, and infestation by nonnative species.

Permanent vegetation removal and disturbance as a result of treatments within the project area would cumulatively impact native vegetation in the analysis area. These actions would contribute to potential spread of nonnative species from increased vehicular movement throughout the analysis area. These impacts are expected to be mitigated through the application of design features so it is not anticipated that cumulative adverse impacts would result from the implementation of the Proposed Action coupled with other restoration activities.

Overall, the cumulative impacts of these actions when added to the impacts of the Proposed Action would create a synergistic effect with respect to reducing risk of severe and uncharacteristic fire upon the landscape and WUIs.

Summary

Under the Proposed Alternative, up to 18,000 acres would be treated by thinning and/or mastication and up to 38,000 acres would be treated by prescribed fire. These actions are intended to have two essential objectives: the reduction of fuel loadings; surface, ladder, and canopy; as well as the reestablishment of fire upon the landscape as a naturally occurring and desirable ecological process. Beyond these two, other vegetation-based objectives, such as ecological resilience, forest health, catastrophic wildfire risk reduction, and old growth promotion and retention; are to be met through the achievement of these primary two objectives.

Modeling of the Proposed Action show long-term improvements relative to the No Action Alternative in all categories considered: BA, canopy cover, total flame length, crowning index, torching index, and canopy base height. The models also indicate the proposed treatments would successfully shift the current ratios of seral state development (grass/forb/shrub, early-open, early-closed, late-open, late-closed) in the three target ERU toward the desired future conditions (U.S. Forest Service 2020a).

3.3 Fire and Fuels

The focus of this section is to analyze the following concerns and questions raised during public scoping related to fire and fuels:

How effective would treatments be / how likely would treatments be to improve ecosystem resilience over time?

What model of risk assessment was used and would be used to determine treatment locations?

3.3.1 Affected Environment

Natural and planned fires provide numerous ecosystem services benefitting the environment and people. Fires increase biodiversity by creating a mosaic of stand conditions and landscape types beneficial to wildlife (e.g., snags, coarse woody debris, or forage). Fires provide support and regulating ecosystem services by contributing to proper nutrient cycling, increased tree health, reduced competition and water stress, increased resistance and resilience from subsequent disturbances (e.g., insect outbreaks, disease, or drought), and restored species compositions (e.g., removal of white fir or other fire sensitive species in frequent-fire ecosystems). Support or provisioning benefits to humans from the restoration of more natural fire regimes may include, increased grass growth (e.g., forage), which could support livestock grazing, benefitting local ranchers; increased health and vigor of residual trees leading to more valuable timber or the development of old-growth forest characteristics; beautiful aspen vistas; open forest conditions that ease access for collecting forest products; and the protection of property and other valuable resources from future fires.

Analysis of natural fire regimes, Vegetation Condition Classes (VCCs), and the historical fire regimes in the Southern Sangre de Cristo Mountains, combined with current fuels, potential wildlife behavior, and fire danger shows that most of the SFMLRP area does not meet the Forest Plan's desired conditions for wildfire behavior. Current conditions may result in high-intensity, widespread, damaging wildfires.

Fuels

Fuels include snags and coarse woody debris, as well as smaller diameter woody debris, needles, leaves, grasses, and other flammable materials on the forest floor. Fuels also include ladder fuels, which are shrub or tree species that create vertical connectivity from the forest floor to the dominant canopy layer. The presence of ladder fuels in frequent-fire forests greatly increases the risk of canopy fires occurring, increasing fire severity and often leading to fire spread over larger areas.

Fuels are generally measured in tons per acre. Within the SFMLRP area, desired fuel conditions differ by ERU, ranging from 1 to 3 tons per acre within pinyon-juniper grasslands and juniper grasslands to 5 to 15 tons per acre within mixed conifer-frequent fire forests. Within the SFMLRP area, the overall average fuel level ranges from 18 to 33 tons per acre (U.S. Forest Service 2021e:Table 16); overall values exceed the natural range of variability. This is a result of fire exclusion, which has caused unnaturally dense forest stands with high levels of surface and ladder fuels.

Fire Behavior

Fire behavior is the manner in which a fire reacts to the influences of fuel, weather, and topography. Fire behavior is typically modeled at the flaming front of the fire and described most simply in terms of fire intensity (flame length) and rate of forward spread. The implications of observed or expected fire behavior are important components of suppression strategies and tactics, particularly in terms of the difficulty of control and effectiveness of various suppression resources.

Desired fire behavior includes average flame lengths no greater than 4 feet under 90th-percentile burning conditions (very high fire weather and fuels conditions, occurring during 10% of the days of the fire season) in most ERUs. The Interagency Fuel Treatment Decision Support System (IFTDSS) was used to model existing condition wildfire behavior. At existing conditions, flame lengths over approximately 60% of the SFMLRP area are modeled to be greater than 4 feet and generally too intense for safe and effective fire suppression by ground resources (Table 13 of U.S. Forest Service 2021e; Figure 3.10).

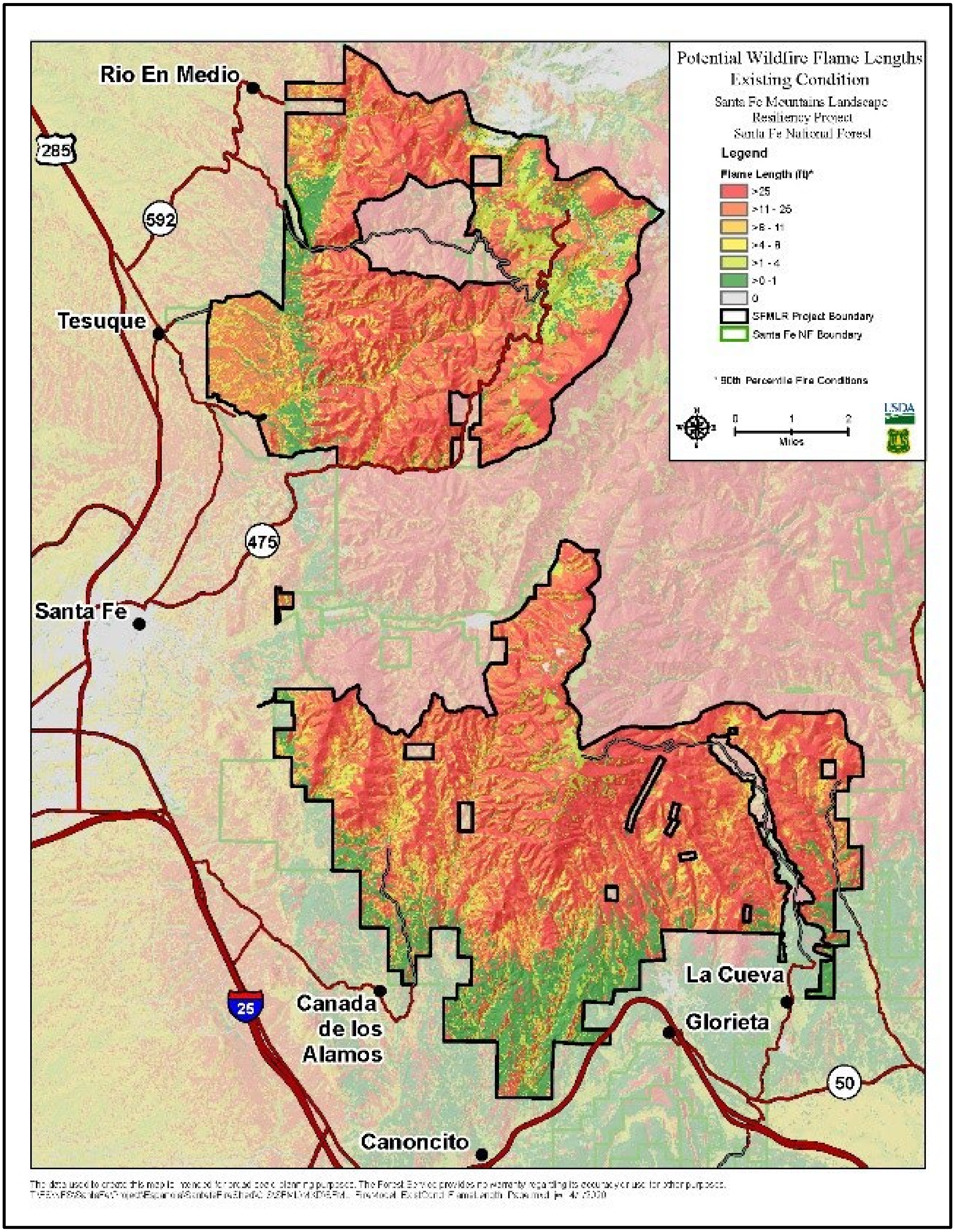


Figure 3.10. Existing condition: modeled wildfire flame lengths.

Crown Fire Activity

Surface fire burns loose debris on the ground surface; such debris includes dead and downed logs, branches, leaves, low vegetation, litter, and duff. Passive crown fire burns the crowns of trees; in this case, trees or groups of trees are torched and ignited by the passing front of a fire. Active crown fire develops a solid flame in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other.

IFTDSS projected that, given existing conditions, passive or active crown fire activity would burn forest canopies over approximately 74% of the SFMLRP area (Table 13 of U.S. Forest Service 2021e; Figure 3.11).

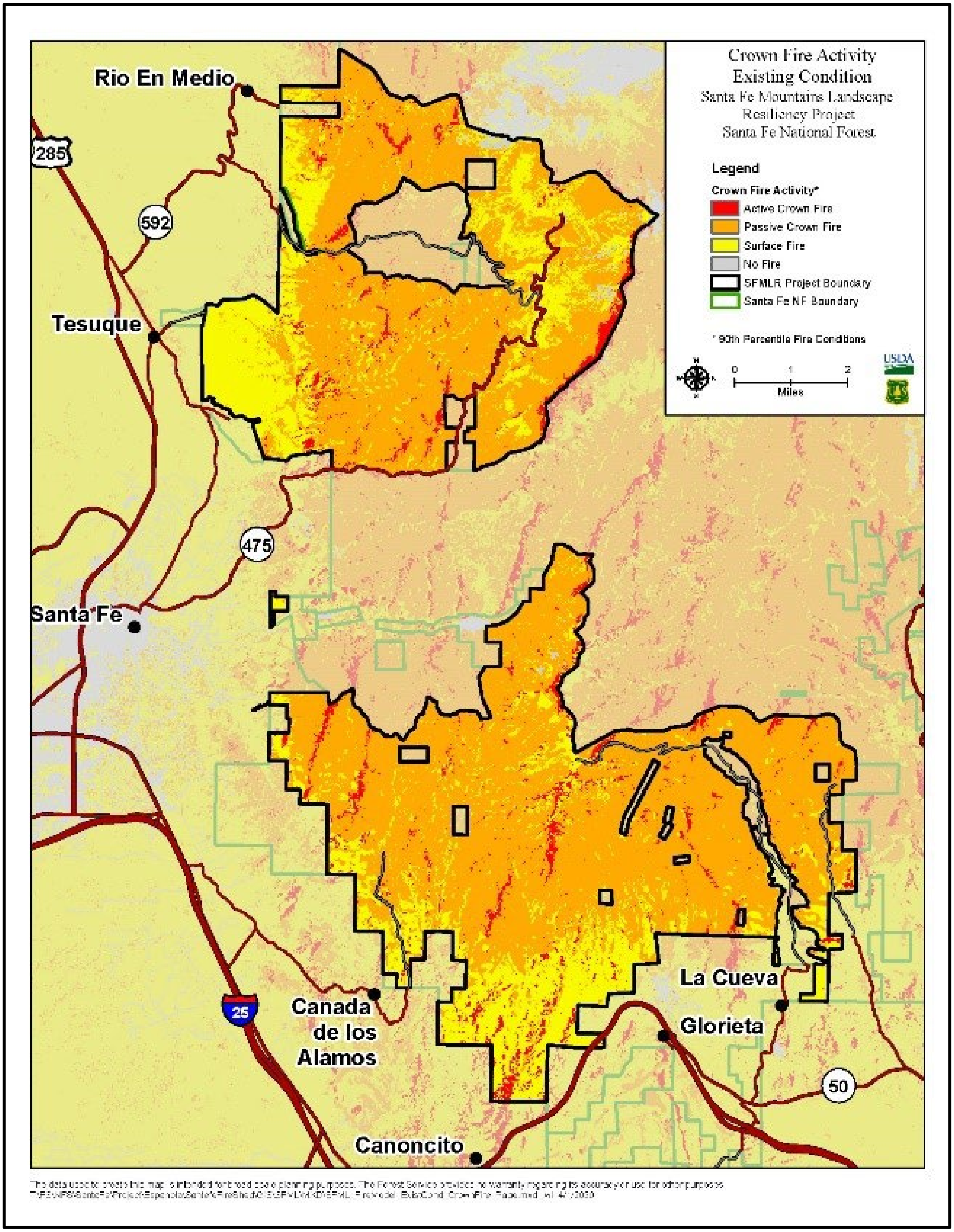


Figure 3.1. Existing condition: modeled wildfire crown fire activity.

Fire Danger

The U.S. Forest Service operates two fire weather Remote Automated Weather Stations (RAWSs) in the Santa Fe Mountains that are representative of the SFMLRP area's weather conditions. Useful data from the stations range from 12 to 17 years. The National Fire Danger Rating System shows variable but steady fire danger (represented by Energy Release Component and Burning Index) at the Santa Fe RAWS from 2007 through 2018 and at the Truchas RAWS from 2002 through 2018, suggesting that potential flame lengths and potential total heat release per unit area has stayed relatively constant over the period of record; this applies to forested stands in the Santa Fe Mountains if the area burns under ninetieth-percentile wildfire conditions (NWCG 2019b).

Fire Hazard

In the wildland fire community, the term "hazard" is used to define a variety of conditions or situations where damage to assets by fire is evaluated. Hazard is quantified and categorized based on the probability of a fire occurring at a specific point under a specific set of locations, and flame length if a fire were to occur. In IFTDSS, Integrated Hazard combines two important measures—burn probability and conditional flame length—into a single characteristic that can be mapped.

Using the IFTDSS model, approximately 31% of the SFMLRP area is at higher to highest hazard of burning, 30% is at middle hazard, 37% is at lowest to lower hazard, and 2% has a hazard level of non-burnable or burnable but not burned (Figure 3.12 and Table 3.13).

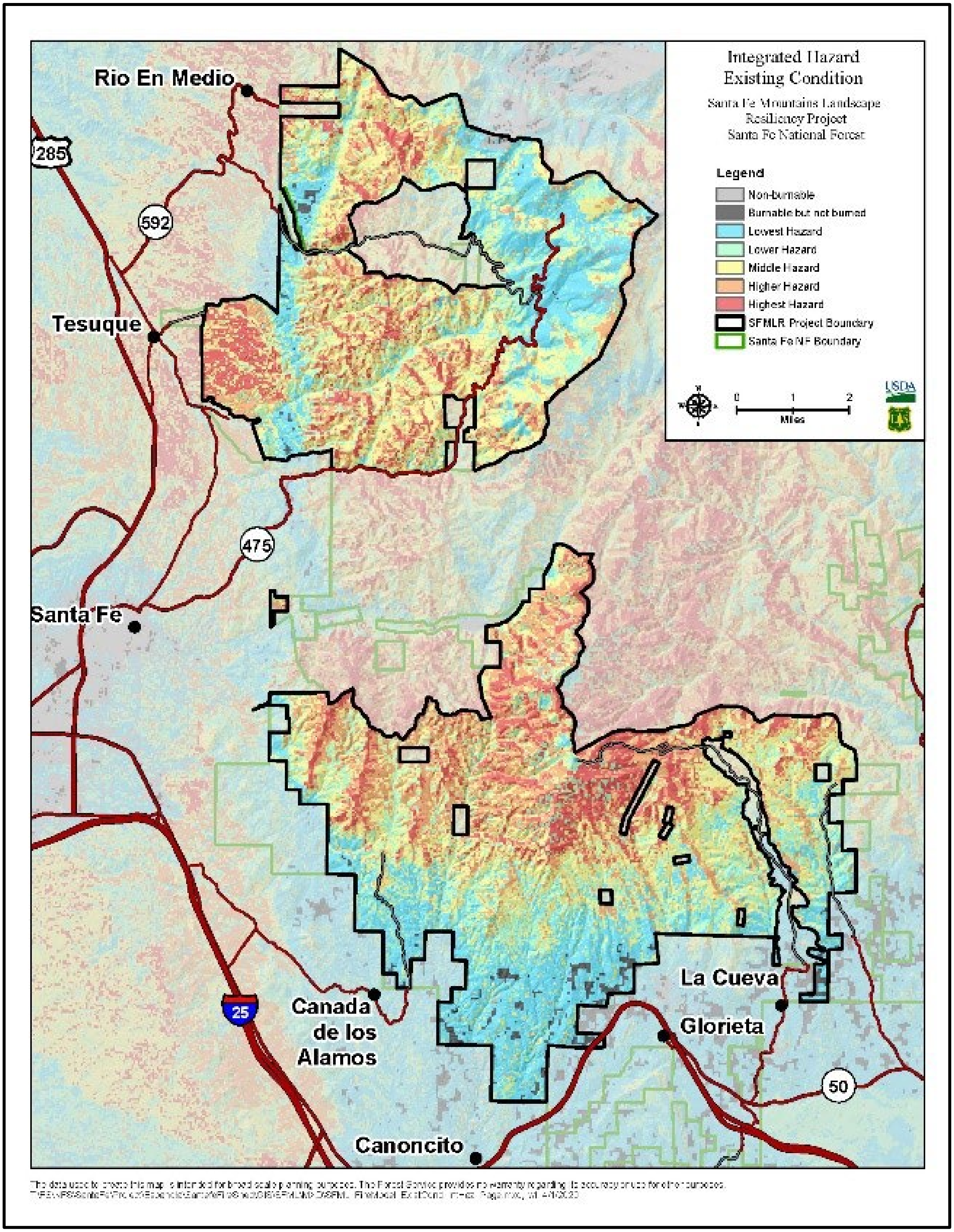


Figure 3.2. Existing condition: wildfire integrated hazard.

Table 3.12. Modeling of Existing Condition Integrated Hazard under Very High Fire Danger (90th Percentile Burning Conditions) for the SFMLRP Area

Lowest Hazard (acres)	Lower Hazard (acres)	Middle Hazard (acres)	Higher Hazard (acres)	Highest Hazard (acres)	Non-Burnable or Burnable and Not Burned (acres)
10,018	8,744	15,166	9,911	5,812	916

In the Coalition's 2018 Wildfire Risk Assessment, Bassett studied the threat from wildfire to valued resources and assets (VRAs). VRAs include tangible assets like homes, as well as abstract concepts like the flood mitigation potential of a stand of trees (Table 7 in the Wildfire Behavior, Air Quality and Climate Change Specialist Report) (Bassett 2018). Under existing conditions, following the next fire, negative expected net value change is high throughout the SFMLRP area, although there are areas where such a fire is not expected to have a negative outcome. Figure 3.13 represents the expected net value change to VRAs following a future fire. In the figure, each risk level is classified into bins (gradation of shades from red to blue) that represent a doubling of wildfire risk. The transition between colors represents a doubling of risk. Dark red areas are expected to lose the most value relative to other areas, while dark blue areas are expected to increase in value relative to other areas.

Figure 42 in U.S. Forest Service 2021e shows the locations of communities and infrastructure resources in and surrounding the SFMLRP area (IFTDSS 2020). Extensive research by Jack Cohen and others has shown that the majority of homes that are susceptible to exterior ignition are damaged or destroyed by wildfires from windblown fire embers or fire brands, and to a lesser extent by radiant heat or direct flame contact from other burning homes or adjacent burning materials (Cohen 2000a, 2000b, 2001, 2004; Cohen and Stratton 2003, 2008). Figure 43 in the report shows the potential distances that fire embers and brands that are produced by crown fire could ignite structures out ahead of a wildfire burning under 90th-percentile burning conditions. The spotting distances in the figure range from 1 to 1,600 feet, with the vast majority of spotting occurring from 1 to 1,000 feet.

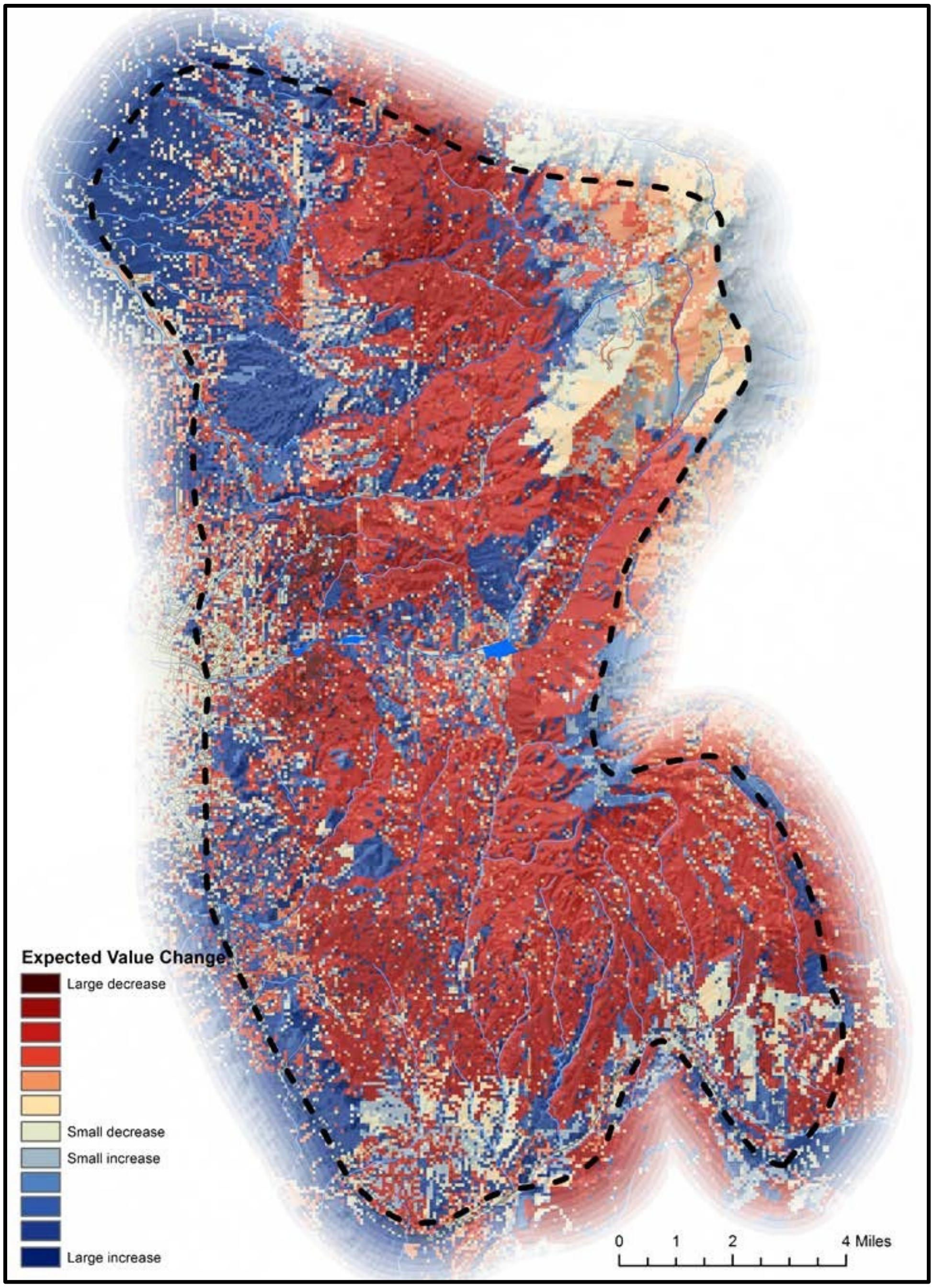


Figure 3.3. Expected net value change for all VRAs included in the Greater Santa Fe Fireshed Coalition's Wildfire Risk Assessment (Bassett 2018).

VEGETATION DYNAMICS DEVELOPMENT TOOL

As part of the Forest Plan revision, a Vegetation Dynamics Development Tool (VDDT) (ESSA 2006) analysis was completed using models based on a historic reference period to determine the degree of departure of fire regimes, including fire frequency and severity. These VDDT state and transition models both define seral states for each ERU and allow comparison among management scenarios. Model results are not precise predictions but indicate relative trends and are sensitive to changes in management or disturbance. Research considers the historic reference period to be prior to European-American settlement, when extensive land-use patterns changed with the introduction of grazing, fire suppression, and forest fragmentation. The projected changes to vegetation derived from the analyses were given a departure rating based on the degree to which they differed from desired conditions (Table 3.14). These fire regime departure ratings help build a greater picture of ERU condition in the planning area. Table 3.15 shows the VDDT values for the various ERUs within the SFMLRP area (U.S.Forest Service, 2016).

Table 3.13. Scales of Departure for Vegetation Analysis

Departure	Range (%)
Low	0–33
Moderate	33–66
High	66–100

Table 3.14. VDDT Analysis Showing the Degree of Seral State Departure from Reference Conditions for selected ERUs within the SFMLRP Area

System	ERU Name	Departure	Departure Index (%)
Forest	Ponderosa pine forest	High	97
Grassland	Colorado Plateau/Great Basin	High	93
Forest	Mixed conifer - frequent fire	High	74
Forest	Spruce-fir forest	Moderate	54
Forest	Mixed conifer with aspen	Moderate	47
Woodland	Juniper grassland	Moderate	45
Woodland	Pinyon-juniper woodland	Low	28

Departure is broken into thirds (0% to 33% = low departure, 34% to 66% = moderate departure, 67% to 100% = high departure).

Vegetation Condition Class

VCC represents a simple categorization and indicates the general level to which current vegetation is different from the simulated historical vegetation reference conditions. Due to fire exclusion, most of the forest stands in the Santa Fe Mountains are in VCC IIa (moderate to low vegetation departure) and IIb (moderate to high vegetation departure) (LANDFIRE 2014; IFTDSS 2020).

HISTORICAL FIRE REGIMES IN THE SOUTHERN SANGRE DE CRISTO MOUNTAINS

In a recent 2020 study of historical fire regimes in the southern Sangre de Cristo Mountains, Margolis et al. (2020) found fire scars dating back to the early 1300s; the last recorded fire burned in 1902 (see Figure 3 in U.S. Forest Service 2021e for a map of tree ring fire scar plots).

FIRE FREQUENCY

The dry conifer forests at the southern extent of the Rocky Mountains historically burned frequently. These fires were predominantly low in severity. This is similar to other dry conifer forests of the region (Swetnam and Baisan 1996) and across the West (Taylor and Skinner 2003; Brown et al. 2008). Fires occurred in consecutive years on multiple occasions, but usually in different locations, suggesting a fuel limitation immediately following fire that prevented reburning. Individual plots burned less frequently, on average (7- to 32-year median intervals). Widespread fires (those which burned at least half of the plots and crossed watersheds) occurred relatively frequently (e.g., 20-year intervals).

These fire frequency estimates at different spatial scales are useful for planning fire treatments and fire frequency for fire regime restoration and maintenance burning. For 300 years (1600–1902), the longest period without a fire in the analysis area was 10 years (1892–1902). The current fire-free interval (119 years) is over 11 times the historical maximum fire-free interval. These fire frequency estimates are similar to other studies across the region (Swetnam and Baisan 1996).

3.3.2 Environmental Consequences

Methods and Assumptions Used for Analysis

METHODOLOGY

Relevant documents were reviewed to determine compliance with applicable legal, regulatory, and policy requirements and direction.

For the current condition and post-treatment wildfire behavior analysis, several data sources and models were used. The Santa Fe Mountains fire weather was downloaded from a National Wildfire Coordinating Group (NWCG) data library. The FireFamily Plus fire weather analysis model was used to determine ninetieth -percentile burning conditions in the Santa Fe Mountains (Appendix A of U.S. Forest Service 2021e). The IFTDSS was used to model pre- and post-treatment wildfire behavior and burn probability. The First Order Fire Effects Model (FOFEM) was used to estimate wildfire and treatment fuel loading.

ASSUMPTIONS

The IFTDSS is a web-based application designed to make fuels treatment planning and analysis more efficient and effective. IFTDSS model runs used LANDFIRE 2014 GIS base map layers. The map layers were updated on February 2, 2020, with the LANDFIRE 2016 edition, but IFTDSS Default Fuels Treatment Edit Rules are not yet compatible with LANDFIRE 2016. In addition to a wildfire scenario, three treatment scenarios were used for the IFTDSS analysis. The thinning scenarios do not fully align with the Proposed Action due to the limited treatment scenario options available in IFTDSS.
The Proposed Action calls for thinning trees less than 16 inches dbh, only in areas where it is needed to safely reintroduce prescribed fire into the landscape. The scenarios are used here to provide an indication of the general range of potential post-treatment wildfire behavior and burn probabilities that can result from thinning and prescribed fire.

- Low-Severity Prescribed Fire: Prescribed burning with resulting mortality of aboveground vegetation <25%.
- Light Thinning / Pile Burning: Thinning stands to ~80% of present density by removing understory up to 8 inches dbh. Subsequently pile burning thinned material.
- Heavy Thinning / Pile Burning: Thinning stands to ~35% of present density with no upper diameter limit.

First Order Fire Effects Model (FOFEM)—First order fire effects are those that concern the direct or indirect or immediate consequences of fire. First order fire effects form an important basis for prediction of secondary effects such as tree regeneration plant succession, and changes in site productivity. These long-term effects generally involve interaction with many variables (for example, weather, animal use, insects, and disease) and are not predicted by this program. Currently, FOFEM provides quantitative fire effects information for tree mortality, fuel consumption, mineral soil exposure, smoke emissions, and soil heating. FOFEM default fuel loading inputs were based on SFMLRP ERU values. The fuel consumption and smoke emissions modules were used for this analysis (Appendix A of the Fuels and Wildfire

Behavior – Air Quality – Climate Change and Carbon Sequestration Specialist Report [U.S. Forest Service 2021e]).

FlamMap (FARSITE) Spotting Distance—The FlamMap fire mapping and analysis system describes potential fire behavior for constant environmental conditions (weather and fuel moisture). Fire behavior is calculated for each pixel within the landscape file independently. Potential fire behavior calculations include surface fire spread, flame length, crown fire activity type, crown fire initiation, crown fire spread, and spotting distance. Spotting is produced whenever some form of crown fire develops (passive and active crown fire). The spotting model in FARSITE does not intend to predict the number of embers produced, or exact locations that embers will land, only the direction and distance embers might land. Depending on topography, Albini's equations may suggest the farthest spotting distances are produced by larger particles that aren't transported over deep ravines. The torching tree model of ember lofting was not intended for representing ember lofting from a running crown fire. It will likely underestimate both the ember sizes, lofting height, and ultimate spotting distances under conditions of running crown fire.

Spatial and Temporal Context for Effects Analysis Including Cumulative Effects

The spatial boundary for analysis of fuels and fire behavior is the SFMLRP area and Santa Fe watershed. The temporal boundary is up to 10 years, which is the longest time period the IFTDSS model can forecast. Existing conditions are used as a conservative proxy for the No Action Alternative. Although wildfire risk would likely increase as vegetation continues to depart from the desired condition, natural fuels conditions would not be expected to change significantly during the 10-year modeling window unless there are high amounts of forest mortality from drought, insect and disease.

Resource Indicators

Table 3.16 shows resource indicators and measures for analysis of fuels and wildland fire behavior related to forest thinning and prescribed burning. Please see the Santa Fe Mountains Landscape Resiliency Project: Fuels and Wildfire Behavior – Air Quality – Climate Change and Carbon Sequestration report for other quantitative fire and fuel modeling results (U.S. Forest Service 2021e).

Table 3.15. Resource Condition Indicators and Measures for Assessing Effects

Indicator or Measure	Definition
Fireline Intensity: Flame length	Flame length is typically measured in feet. Flame lengths under 4 feet in height typically can be attacked, using hand tools, at the head or flanks by constructing handline, burning out and holding. Handline should hold the fire. Fires with flame lengths over 4 feet are too intense for direct attack on the head by persons using hand tools. Equipment such as dozers, engines, and retardant aircraft can be effective. Fires may present serious control problems such as torching, crowning, and spotting. Control efforts at the head of the fire will probably be ineffective.
Crown Fire Activity: Active Crown Fire	Crown Fire Activity is reported in IFTDSS in acres. This metric indicates how many acres of the project area could be subject to active crown fire, meaning areas that develop a solid flame in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other.
Integrated Hazard: Highest Hazard	Integrated Hazard in IFTDSS is reported in acres. This metric combines two important measures—burn probability and conditional flame length—into a single characteristic that can be mapped.

Alternative 1: No Action Alternative

Under the No Action Alternative, current management plans would continue to guide the management of the project area. No prescribed burning, vegetation and restoration treatments, or road maintenance, would be implemented to accomplish project goals within the project area, unless approved through a separate NEPA document and decision. Without implementing the treatments, forest conditions would continue to depart from desired conditions and the existing conditions described under the affected environment section 3.3.1 (above) would persist, if not decline.

The risk of fire with uncharacteristic fire severity and intensity would continue to increase within the project area. Modeling of very high wildfire behavior shows that most of the project area is currently at risk of sustaining high intensity, widespread, damaging fire and the risk of fire with uncharacteristic fire severity and intensity would continue to increase within the project area. Wildfires would generally be too intense for safe and effective fire suppression action by ground resources. Increases in stand density and proliferation of ladder fuels would continue.

Fuel loading, particularly in the understory, would continue to increase, elevating the wildfire hazard of overstory woodland and forest species. Forest surface, crown foliage and branchwood fuel loads in the project area would continue to range from approximately 18 to 33 tons per acre and would continue to increase over time. This is a result of fire exclusion that has caused unnaturally dense forest stands with high amounts of ladder and surface fuels.

Forest structure would continue to transition into a homogenous state and would continue to be dominated by a single age class. Key compositional and structural elements of forest stands would not be treated and ecological resistance and resiliency to environmental disturbance would be limited. Conifer forests would continue to exhibit overgrown and unnaturally high densities. Stands would continue to be vulnerable to impacts of warmer temperatures and decreased precipitation resulting from climate change (Allen et al. 2010; Gutzler 2013; Gutzler and Robbins 2011; Llewellyn and Vaddey 2013; Seager et al. 2008) as well as more frequent insect and disease outbreaks; overall forest health would decline.

Forests would lack the desired level of diversity in structure, species composition, and density.
Forest susceptibility to insects and disease (e.g., bark beetles, defoliators, and mistletoe) would continue to increase. Increased incidences of insect and disease resulting from increasing tree physiological stress could alter landscape spatial composition of all ERUs. Under projected climate change forecasts, the natural range of variability for each ERU may not be sustainable in the long term (Fulé 2008), and with atypical disturbances like large-scale insect and disease, changes to the composition of the ERU may be irreversible or permanent.

A lack of prescribed fire could preclude any beneficial impacts to woodland and forest vegetation that may result from the addition of ash, organic matter, and nutrients to the soil. Native herbaceous understory vegetation would be more productive and tree sapling densities lower with frequent low-severity surface fires. Fire-adapted ecosystems would not be maintained and/or restored and could cause a decline in vegetation health, vigor and resiliency, species composition, and overall plant diversity. The absence of vegetation thinning treatments and prescribed fire to reduce hazardous fuel loads, would keep the current overgrown forests with unnaturally (pre-European settlement) high fuel loads that result in catastrophic high-severity wildfire. Unplanned ignitions could quickly transition to fast-moving wildfires which burn with greater intensity, take longer to extinguish, and burn more acres. Uncharacteristic stand-replacing fire would exhibit intense fire behavior, including active crown fire, with extreme spread rates and flame lengths; extreme fire behavior would limit the ability of firefighters to suppress the fire safely, resulting in large number of acres potentially undergoing stand replacement, which results in high levels of tree mortality and potential for long-lasting adverse impacts to natural and cultural resources. This could result in short-term (one to two growing seasons) and long-term (decades) adverse impacts to vegetation communities, particularly non-fire-adapted vegetation communities.

Adverse impacts of wildfire include increased use of indirect suppression tactics, such as aerial retardant use and backfiring of large units from superior holding features resulting in larger areas burned, the removal of vegetation along containment lines resulting in the direct loss of individual plants, trampling of vegetation communities during suppression activities from firefighters, and equipment and vehicles causing crushing or removal of vegetation in localized areas. Suppression actions could also contribute to the spread of invasive nonnative species through transport on firefighting apparatuses.

Ultimately, the landscape would not be moved toward desired conditions, and as such, the No Action Alternative would not meet the purpose and need for the project.

Alternative 2: Proposed Action

THINNING AND PRESCRIBED BURNING DIRECT AND INDIRECT EFFECTS

Implementation of the Proposed Action would reduce project area surface and ladder fuels and create strategically located treatments along ridges and forest roads. In dense stands, forest stand thinning and prescribed burning would reduce surface, ladder, and crown fuels. The project would thin forest stands using tree felling and mastication. Activity slash and masticated fuels would be reduced by piling and burning, jackpot and broadcast burning. The use of lop and scatter slash disposal techniques would increase surface fuel loading. Excessive slash fuels that would produce undesirable flame lengths or fire behavior, would be removed to off site or pile and jackpot burned in order to reduce surface fuel loadings prior to broadcast prescribed burning or underburning. In units where mechanical thinning is not needed to reduce ladder and crown fuels prior to burning, prescribed burning would reduce surface and ladder fuels and, to a lesser extent, crown fuels through isolated tree torching. Under the Proposed Action, vegetation thinning and prescribed burning treatments would reduce overall average surface fuels from 18 to 33 tons per acre to approximately 4 to 14 tons per acre. Post-treatment ponderosa pine forest surface fuel loads would be 1 ton less per acre than the desired condition range, and mixed conifer–frequent fire forest surface fuel loads would be 2 tons higher than the desired condition range (see Table 17 in the U.S. Forest Service 2021e). It is anticipated that post-treatment fuel loading would be reduced to amounts that would produce average flame lengths no greater than 4 feet under 90th-percentile wildfire burning conditions.

Removal of small-diameter trees would decrease TPA and decrease BA. Understory thinning would eliminate some of the lower portion of the forest canopy, increasing the overall crown base height of the remaining forest canopy and reducing the potential for surface fires to transition into the forest canopy; this would thereby increase the surface fire intensity required to ignite the crowns (Agee and Skinner 2004; Graham et al. 2004; Peterson et al. 2005; Cram et al. 2006). Decreasing crown bulk density would reduce the ability of fire to spread horizontally through the forest canopy if the fire does transition from the surface layer into the canopy (Agee and Skinner 2004; Graham et al. 2004; Peterson et al. 2005).

IFTDSS modeling showed that all of the treatment types would be effective in reducing wildfire behavior, reducing integrated hazard, and meeting desired conditions within the first few years after treatments are completed. In areas treated with prescribed burning only, the number of acres burning with reduced wildfire behavior (flame lengths less than 4ft and transition from crown to surface fire) would diminish after 2 to 5 years, but without maintenance burning, fire behavior would increase 6-10 years post treatment (Table 3.17). Compared to prescribed burn only, wildfire behavior and integrated hazard would decrease in areas that are treated with light thinning and prescribed fire. Wildfire behavior and integrated hazard would be lowest in areas treated with heavy thinning and prescribed fire (see Table 3.17) (U.S. Forest Service 2021e:Figures 33–41).

Table 3.16. Modeling of Wildfire Behavior and Integrated Hazard under Very High Fire Danger (90th-percentile) Conditions 2 to 10 Years After Treatments are Completed for the SFMLRP

Treatment	ERU	Flame Lengths >4 feet (acres)	Flame Lengths >4 feet (acres)	Active Crown Fire (acres)	Active Crown Fire (acres)	Highest Hazard (acres)	Highest Hazard (acres)
		2 to 5 years	6 to 10 years	2 to 5 years	6 to 10 years	2 to 5 years	6 to 10 years
No Action Existing Condition*	All ERUs	39,041	–	2,426	–	5,812	–
Prescribed Burning Only	Juniper Grass	32.0	68.4	0.3	0.5	0	
	Mixed Conifer – frequent fire	4,861.7	13,233.2	330.4	536.6	0	1,304.0
	Pinyon-Juniper Woodland	1,446.7	3,921.4	8.6	16.8	0	73.4
	Ponderosa Pine Forest	2,819.9	9,031.5	89.5	164.9	0	222.6
Light Thinning Prescribed Burning	Juniper Grass	18.7	46.9	0	0	0	0
	Mixed Conifer – frequent fire	4,320.7	12,941.6	102.8	157.0	0	341.7
	Pinyon-Juniper Woodland	1,113.5	3,568.8	4.4	5.1	0	2.2
	Ponderosa Pine Forest	2,254.4	7,728.3	42.3	54.9	0	46.0
Heavy Thinning Prescribed Burning	Juniper Grass	15.2	18.7	0	0	0	0
	Mixed Conifer – frequent fire	1,096.7	1,590.9	0	0	0	0
	Pinyon-Juniper Woodland	1,526.0	1,853.9	0.2	0	0	0
	Ponderosa Pine Forest	1,066.0	1,655.2	0.2	0	0	0

Source: IFTDSS (2020).

* Data for the No Action Alternative are based on modeling of existing conditions and are not available projected out to 2–5 or to 6–10 years.

PUBLIC HEALTH AND SAFETY

The implementation of the Proposed Action and other planned projects would reduce wildfire behavior in close proximity to and improve the protection of homes and infrastructure resources located along the SFNF boundary that are at risk from damage by wildfires. Compared to crown fires, surface fires produce far fewer embers and brands (both of which can cause combustible materials to ignite out ahead of the main wildfire). The goal of the treatments would be to reduce wildfire average flame lengths to <4 feet, reduce crown fire activity and fire ember or fire brand production, and increase firefighter safety and fire suppression effectiveness. After proposed treatments are completed, crown fire potential would be reduced, and uncontrolled wildfires would primarily burn in surface fuels. Fuel treatments that increase crown separation, increase crown base heights and reduce stand density would reduce the amount of embers and brands that would be lofted ahead of the flaming front, reaching homes adjacent to the treated area. Implementation of mitigation measures Air-1 through Air-6 would further reduce impacts to public health and safety.

Cumulative Effects

See Table 3.1 for a list of present and reasonably foreseeable future actions considered for cumulative effects on fire and fuels. Spatial and temporal boundaries for cumulative impacts analysis are the same as described above.

Ongoing and planned fuel reduction projects would continue to occur on adjacent tribal lands and other federal, state, and private lands surrounding the project area. Restoration activities would occur on adjacent public lands, including, but not limited to, the Aztec Springs (Phases 2 and 3), Aspen Ranch, Vigil Grant, Hyde Memorial State Park, and Santa Fe Municipal Watershed projects, would also increase ecosystem resilience in the analysis area. Combined, these projects would treat up to approximately 34,000 acres over the next decade. These would have cumulative short-term adverse and long-term beneficial impacts to fire and fuel resources. Short-term adverse impacts include temporary, localized removal or disturbance of vegetation as a result of vegetation thinning and prescribed fire treatments. Mechanical treatments and other restoration activities on the adjacent state lands and tribal lands would further increase long-term forest health.

Actions to restore native vegetation and reduce hazardous fuels within the project area and surrounding lands cumulatively influence potential fire behavior. Vegetation thinning treatments and use of fire help to reduce hazardous fuel loading, break up fuel continuity on a landscape scale, and return native vegetation communities to within a closer approximation of their natural range of variability. In the short term and long term, surface and canopy fuel loading is reduced. In the event that a wildfire ignition occurs under these mitigated fuel conditions, there is less potential for catastrophic wildfire and therefore fewer adverse short- and long-term impacts.

Overall, the cumulative impacts of these actions, when added to the impacts of the Proposed Action, would have beneficial impacts on vegetation for many years post treatment as a result of improved ecosystem functioning, resiliency, and reduced potential for severe wildfire and unwanted fire effects.

Summary

Under the Proposed Action, most of the project treatment areas would move toward meeting desired conditions. Compared with the No Action Alternative, implementation of the Proposed Action would significantly reduce the potential of damaging wildfires occurring in the treated areas for about one decade.

After 10 years, vegetation growth and fuels accumulations would increase wildfire intensities toward existing, no action conditions. Subsequent implementation of prescribed fire and the management of wildfires to meet resource benefit purposes would be used to maintain frequent forest fire regime areas within the natural range of variability. Doing so would also increase the forest ecosystem's resistance to the adverse effects of climate change and increase their sustainability over time.

Implementation of the Proposed Action would reduce the potential of windblown fire embers or brands from igniting homes adjacent to federal land. After treatments are completed, uncontrolled wildfires would mostly burn in surface fuels and there would be a significant reduction in crown fire behavior. Compared to crown fires, surface fires produce far less embers and brands that would be blown by the wind towards homes, therefore fuel treatments designed to reduce crown fire propagation would reduce the number of embers and brands that would reach homes adjacent to the treated area. Under the No Action Alternative, tree crowns burning in wildfires would produce uncontrolled numbers of fire brands that could ignite homes.

Table 3.18 show a summary of resource indicators and the effects of the Proposed Action and No Action Alternative. Compared with the No Action Alternative, the Proposed Action would reduce fuel loadings and reduce potential fire danger and damaging wildfires.

Table 3.17. Summary of Resource Indicators and Measures for the Proposed Action and No Action Alternative

Resource Indicator	No Action Alternative	Proposed Action
Crown Fire Activity: Active Crown Fire	Fuel loading and fuel continuity (vertical and horizontal) would continue to support active crown fire activity across the majority of the project area in ERUs that typically experience crown fire spread (Mixed Conifer-Frequent Fire and Ponderosa Pine Forest). Active crown fire is projected to occur on 5,812 acres across ERUs.	Reduction in fuel loading and continuity would mitigate the propagation and spread of active crown fire in ERUs capable of typically supporting crown fire spread (Mixed Conifer-Frequent Fire and Ponderosa Pine Forest). In the short term (2–5 years), under a prescribed fire only scenario, active crown fire across ERUs is projected to decrease by approximately 92% compared to the No Action. In the short term (2–5 years), under a light thin and prescribed fire scenario, active crown fire across ERUs is projected to decrease by approximately 97% compared to the No Action. In the short term (2–5 years), under a heavy thin and prescribed fire scenario, active crown fire across ERUs is projected to decrease by approximately 99.9% compared to the No Action. In the longer term (6–10 years) under a prescribed fire only scenario, active crown fire across ERUs is projected to decrease by approximately 88% compared to the No Action. In the long term (6–10 years), under a light thin and prescribed fire scenario, active crown fire across ERUs is projected to decrease by approximately 96% compared to the No Action. In the long term (6–10 years), under a heavy thin and prescribed fire scenario, active crown fire across ERUs is projected to decrease by approximately 100% compared to the No Action. All of the treatment types would be effective in reducing fire behavior and meeting desired conditions during the first few years after treatments are completed.

Resource Indicator	No Action Alternative	Proposed Action
Integrated Hazard: Highest Hazard	Fuel loading and fuel conditions places about 32% of the project area at the highest hazard (or greatest burn probability under intense flame lengths).	In the short term (2–5 years), all treatments are effective at removing all acres from the highest category of hazard. In the longer term (6–10 years) under a prescribed fire–only scenario, the number of acres projected to fall within the highest hazard decrease by approximately 72% compared to the No Action. In the longer term (6–10 years), under a light thin and prescribed fire scenario, the number of acres projected to fall within the highest hazard decrease by approximately 94% compared to the No Action. In the long term (6–10 years), under a heavy thin and prescribed fire scenario, the number of acres projected to fall within the highest hazard decrease by approximately 100% compared to the No Action. All of the treatment types would be effective in reducing integrated hazard and meeting desired conditions during the first few years after treatments are completed.
Fire Intensity: Flame Length	Wildfire flame lengths over approximately 39,041 acres of the project area would be greater than 4 feet and too intense for safe and effective fire suppression action by ground resources.	In the short term (2–5 years), under a prescribed fire–only scenario, acres supporting flame lengths >4ft across ERUs are projected to decrease by approximately 76% compared to the No Action. In the short term (2–5 years), under a light thin and prescribed fire scenario, acres supporting flame lengths >4ft across ERUs are projected to decrease by approximately 80% compared to the No Action. In the short term (2–5 years), under a heavy thin and prescribed fire scenario, acres supporting flame lengths >4ft across ERUs are projected to decrease by approximately 90% compared to the No Action. In the longer term (6–10 years) under a prescribed fire–only scenario, acres supporting flame lengths >4ft across ERUs are projected to decrease by approximately 32% compared to the No Action. In the long term (6–10 years), under a light thin and prescribed fire scenario, acres supporting flame lengths >4ft across ERUs are projected to decrease by approximately 37% compared to the No Action. In the long term (6–10 years), under a heavy thin and prescribed fire scenario, acres supporting flame lengths >4ft across ERUs are projected to decrease by approximately 87% compared to the No Action. All of the treatment types would be effective in reducing fire intensity and meeting desired conditions during the first few years after treatments are completed.

3.4 Threatened and Endangered Species

The focus of this section is to analyze the following questions:

How would the proposed project impact various MSO habitat types?

How would the proposed project impact Holy Ghost ipomopsis habitat?

3.4.1 Consultation History

Informal Section 7 consultation, including FWS concurrence, was completed for the project on April 19, 2022 (Cons# 02ENNM00-2020-I-1177, ECOSphere Project Code: 2022-0000880). Table 3.19 describes federally threatened and endangered species, identified by the USFWS Information for Planning and Consultation (IPaC) system, that may potentially occur within or in proximity to the project area. U.S. Forest Service biologists reviewed available spatial data, including Critical Habitat (CH) mapping and other habitat designations (e.g., MSO PACs) as well as species occurrence and habitat quality.

Table 3.18. Federally Listed Species Considered for this Analysis

Scientific Name	Common Name	Endangered Species Act Status	Species Present	Critical Habitat Present	Suitable Habitat Present
Strix occidentalis lucida	Mexican spotted owl	Threatened	Yes	Yes	Yes
Zapus hudsonius luteus	New Mexico meadow jumping mouse	Endangered	No known occurrences	No	No
Empidonax traillii extimus	Southwestern willow flycatcher	Endangered	No known occurrences	No	No
Coccyzus americanus	Western yellow-billed cuckoo	Threatened	No known occurrences	No	No
Ipomopsis sancti-spiritu	Holy Ghost ipomopsis	Endangered	Suitable habitat; no known occurrences	No	Yes

3.4.2 Affected Environment

Mexican Spotted Owl

The MSO is the only federally proposed, threatened, or endangered species known to occur and have CH within the project area. Ponderosa pine, mixed conifer and riparian habitat are dominant vegetation types within and adjacent to the project area. Potential nest/roost habitat as well as dispersal and foraging habitat exists for this species. To align the project with the 2012 MSO Recovery Plan, 3,879 acres are designated for management as recovery nest/roost habitat in the project area. A supplemental 2021 Recovery Plan document is located on the project website (U.S. Forest Service 2022c). Five MSO PACs have been delineated in the project area. Monitoring surveys will continue in existing PACs and surveys will be implemented for active nest/roost sites.

The MSO, protected under the Endangered Species Act (ESA), is one of the largest owl species of North America and one of three subspecies of spotted owl that are geographically delineated. The species habitat range covers the southwestern states of Arizona, Utah, Colorado, New Mexico, and Texas, and south to central Mexico (USFWS 2004).

Across the species' range, the MSO normally occupies old-growth forest in mixed conifer, pine-oak woodland, deciduous riparian, or a combination of these habitats that will support a home range of 1,400 to 4,500 acres (USFWS 2012). Habitat also typically has a structured canopy, a perennial water source, and a rodent-dominated prey base of adequate size. MSO home ranges include activity centers that represent concentrated use areas for nesting, roosting, and foraging. Proximal areas to roosting must provide extensive foraging opportunities with dietary preferences relying on small mammals such as mice, woodrats, and voles (National Park Service 2010). Adult birds are faithful to their nesting sites and return year after year to breed in the same location.

The MSO was listed as threatened under the ESA on March 16, 1993 (*FR* 58:14248). Critical habitat originally was designated on March 16, 1993 (*FR* 58:14248), and subsequently revoked on March 25, 1998 (*FR* 63:14378). Critical habitat was designated again on February 1, 2001 (*FR* 66:8530) and further revised to its current extent on August 31, 2004 (*FR* 69:53181). Designated critical habitat is located in Utah, Colorado, Arizona, and New Mexico. The primary threat to MSOs in the United States is the risk of stand-replacing wildfire (USFWS 2012).

Table 3.20 defines and quantifies the known and modeled habitat for MSO within the analysis area as defined by the MSO 2012 Recovery Plan. Since the project was originally scoped in 2019, the Southwest Region (U.S. Forest Service Region 3) has identified and modeled MSO habitat outside of known PACs and designated Critical Habitat. This identification process and resulting regional habitat model has informed the creation of a detailed MSO habitat review procedure (MSO Checklist) which will be implemented throughout the region prior to U.S. Forest Service actions within habitat areas (U.S. Forest Service 2021f, 2022). Section 7 consultation for the project included FWS concurrence based on adherence to all of the Project Integrated Design Features, as identified in Appendix A of the BA, and agreement for on-going coordination with FWS during project implementation. Additional meetings occurred with FWS representatives in September 2022, in response to the Hermit's Peak – Calf Canyon fire. At that time, FWS concurred that the project did not require additional requirements for consultation and that the existing consultation would remain valid.

MSO habitats were greatly impacted by the HPCC Fire of 2022 with effects spanning beyond the fire perimeter, such as displacing individual MSO and reducing the overall quantity and quality of available MSO habitats on the SFNF eastside. The Forest will implement the project with a focus on protecting and improving MSO habitats. When at all possible, treatments would only be conducted outside of designated and delineated MSO habitats. If it is necessary to treat in MSO habitat areas to meet the project desired conditions (specifically catastrophic wildfire risk reduction), then consideration would be given to the overall effects to available MSO habitats post-HPCC fire (such as delineation adjustments for the best available Nest-Roost habitat), and the treatments would be designed and implemented in manner that does not remove the characteristics that contribute to the habitats, such as high basal area of larger trees, and sufficient closed canopy, downed logs and snags. This approach would promote the continued availability of MSO habitats for dispersal and nesting.

Holy Ghost Ipomopsis

Holy Ghost ipomopsis was listed as endangered under the Endangered Species Act of 1973, on March 23, 1994 (FR 94:6790) (U.S. Fish and Wildlife Service 1994). The Holy Ghost ipomopsis (HGI) is not known to occur within or immediately adjacent to the project area. HGI is only known to occur naturally in Holy Ghost Canyon in the Pecos River watershed. Small populations have been introduced in the Pecos River watershed. The closest recorded natural HGI population is approximately 5 miles away from the project boundary and approximately 6.5 miles away from the project's closest proposed treatments. The closest introduced HGI population is located approximately 4.25 miles from the project area.

Holy Ghost ipomopsis inhabits openings in ponderosa pine-Douglas fir forest and generally prefers disturbed areas with relatively low densities of other perennial species. HGI seeds are known to disperse by falling to the ground from the stalk and are then distributed by gravity and water downhill. HGI seeds are not wind transported, nor do they stick to wildlife, thus seed dispersion is highly localized within a very short distance of the parent plant, often within 1 meter (UFSWS 2022). A detailed life history and habitat requirements of HGI is incorporated by reference from the USFWS HGI Recovery Plan (USFWS 2002). Within Holy Ghost Canyon, the species is known to grow on disturbed cut-slopes of Forest Road 122 in an open ponderosa pine forest (USFWS 2002).

Potential immediate threats to this species include small population size, road maintenance, recreation impacts, and catastrophic forest fire. The potential indirect effects of spruce budworm control is another issue that could affect Holy Ghost ipomopsis and that may need management consideration (USFWS 2002). In the long term, preventing natural disturbances that result from events like wildfire reduces the number of early successional sites for this species. The present land uses in the canyon prevent frequent disturbances, which hinders the development of early successional habitats to which HGI is best adapted (U.S. Forest Service 2022).

Suitable habitat may exist in the project area, specifically on west- to south-facing, dry, steep cut slopes within the lower one-third of the slopes along perennial stream drainages (non-riparian areas), similar to where it occurs in Holy Ghost Canyon and where it has survived at reintroduction sites. However, this species has not been documented within the project area during previous biological surveys or project reconnaissance field visits (U.S. Forest Service 2022).

Approximately 27 acres of the SFMLRP area occur within the Glorieta Creek-Pecos River Pecos River watershed (see Section 3.6), adjacent to HGI's known occupied range, and contain suitable HGI habitat based on the species known habitat requirements. The suitable habitat is considered marginal as the area is located farther from perennial water features than HGI population are known to occur (U.S. Forest Service 2022). However, there is potential for HGI to occur within a limited portion of the project area.

Table 3.19. MSO Habitat Types within the Analysis Area

MSO Habitat Type	MSO Recovery Plan Description and Management Actions Summary	Habitat Characteristics and Primary Uses	Habitat Type within the Analysis Area (acres)
Protected Activity Centers (PACs)	"PACs encompass a minimum of 600 acres surrounding known owl nest/roost sites. Management recommendations are most conservative within PACs, but by no means advocate a "hands-off" approach. The Recovery Team recognizes situations exist where management is needed to sustain or enhance desired conditions for the owl, including fire-risk reduction, as well as monitoring owl response. Mechanical treatments in some PACs may be needed to achieve these objectives; determining which PACs may benefit from mechanical treatments requires a landscape analysis to determine where the needs of fire risk reduction and habitat enhancement are greatest. PACs are the only form of protected habitat included in this revised Plan." (USFWS 2012)	• Known nest and roosting sites with annual return and confirmed occupancy • Breeding and reproductive activities • Concentrated occupied habitat with additional activities such as foraging	3,394
Critical Habitat	"Critical habitat for the Mexican spotted owl was designated in 2004, comprising approximately 3.5 million hectares (ha) (8.6 million acres [ac]) on Federal lands in Arizona, Colorado, New Mexico, and Utah (69 FR 53182)."	Primary constituent element for MSO Designated Critical Habitat: • A range of tree species, including mixed conifer, pine-oak, and riparian forest types, composed of different tree sizes reflecting different ages of trees, 30% to 45% of which are large trees with a dbh of 12 inches or more. • A shade canopy created by the tree branches covering 40% or more of the ground. • Large, dead trees (snags) with a dbh of at least 12 inches. • High volumes of fallen trees and other woody debris. • A wide range of tree and plant species, including hardwoods. • Adequate levels of residual plant cover to maintain fruits and seeds and allow plant regeneration.	4,517

MSO Habitat Type	MSO Recovery Plan Description and Management Actions Summary	Habitat Characteristics and Primary Uses	Habitat Type within the Analysis Area (acres)
Nest/Roost Habitat	"This habitat is primarily ponderosa pine-Gambel oak, mixed-conifer, and riparian forest that either currently is, or has the potential for becoming, nest/roost habitat or does or could provide foraging, dispersal, or wintering habitats. Nesting/roosting habitat typically occurs either in well-structured forests with high canopy cover, large trees, and other late seral characteristics, or in steep and narrow rocky canyons formed by parallel cliffs with numerous caves and/or ledges within specific geologic formations. Ten to 25 percent of forested recovery habitat should be managed as recovery nest/roost habitat varying by forest type and EMU (formerly called recovery units). This habitat should be managed to replace nest/roost habitat lost due to disturbance (e.g., fire) or senescence and to provide additional nest/roost habitat to facilitate recovery of the owl. The remainder of forested recovery habitat should be managed for other needs (such as foraging, dispersing, or wintering) provided that key habitat elements are retained across the landscape."	• Nest/roost meets suitable habitat characteristics to support reproductive activities and qualifies for active management for MSO habitat under the 2012 Recovery Plan. • Areas are assumed to be occupied based on suitability, but do not contain known breeding pairs or do not meet metrics to qualify as a PAC. • Habitat may be used for not breeding activity and is often directly surrounding PAC locations.	7,185
Foraging and Dispersal Habitat	Other forest and woodland types, such as ponderosa pine forest, spruce-fir forest, and pinyon-juniper woodland. No specific management is suggested for these habitat types, recognizing that current emphasis for sustainable and resilient forests should be compatible with needs of the owl.	• Habitat is suitable for foraging and dispersal purposes but does not contain suitable nesting or roosting habitat.	For purposes of this analysis, all stands within mixed conifer, ponderosa pine, pinyon-juniper, spruce-fir or riparian ERUs that are not within PACs or recovery nest/roost areas are considered as recovery habitat suitable for foraging and dispersal per the 2012 MSO Recovery Plan (USFWS 2012).

3.4.3 Environmental Consequences

Methods and Assumptions Used for Analysis

The analysis area consists of the geographic extent in which resources may be affected by the Proposed Action. This includes all areas that may be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02).

To analyze potential effects from the proposed project, the analysis area is defined as the project area plus a 0.5-mile buffer. The 0.5-mile buffer corresponds to the survey protocol for MSO and accounts for the area in which project activities may indirectly affect MSO immediately adjacent to the project boundary. The analysis area is approximately 64,782 acres of land managed by the U.S. Forest Service.

The following analysis is based on multiple methodologies for identifying the aforementioned MSO habitat types (see Table 3.20). Those methodologies include project level MSO surveys and management of known PAC locations, as well as project-specific habitat modeling efforts. To inform the analysis of the proposed conditions-based management approaches impact to MSO and its habitat, the U.S. Forest Service identified that it was first necessary to conduct a habitat modeling effort to identify the amount of nest roost habitat within the project analysis area. This model incorporated information based on ERU, tree canopy, vegetation density, and other factors that informed MSO habitat suitability. The full methodology and modeling results are available in a supplemental document on the project website (U.S. Forest Service 2020b). The modeled nest/roost habitat was adopted for the purposes of this analysis, and a habitat confirmation process would be conducted prior to implementation of proposed project treatments (MSO-13).

Assumptions:

- Restoration activities would be implemented in a phased approach over a 10- to 15-year period and distributed across the project area.
- Implementation of proposed vegetation treatments would occur on up to 750 acres for vegetation thinning and up to 4,000 acres for prescribed fire, annually.
- Spatial arrangement and timing of proposed activities within MSO habitat will be conditions-based with treatment designed to meet MSO-specific desired conditions based on present habitat type as outlined in Appendix A and the MSO Recovery Plan.
- Individual vegetation thinning treatment units would vary according to the size and arrangement of appropriate stands on the landscape. In general, stands thinned in a year would be individually smaller than the total acreage thinned that year and discontinuous in spatial arrangement (e.g., multiple separate areas of tens to hundreds of acres each with leave areas within the treatment boundaries due to sensitive resources or steep slopes).
- The prescribed fire treatment units would average 500 to 1,000 acres in size and burning would be done primarily in the fall. Fire intensity would be patchy within the burn unit boundaries, including some unburned refugia.
- All integrated design features (IDFs) (design features, mitigation measures, and best management practices), including species specific measures MSO 1- MSO 14 (detailed in Appendix C), would be implemented as applicable to treatment area conditions and present MSO habitat.
- Pre-treatment surveys and habitat identification would be conducted according to the MSO Recovery Plan and U.S. Forest Service Region 3 MSO Checklist (U.S. Forest Service 2021f).

Alternative 1: No Action Alternative

Under this alternative, there would be no project-related effect on MSO habitat or population trends because proposed project activities would not be implemented. Current management plans would guide existing and previously authorized activities in the project area. There would be no noise or visual disturbance from proposed activities or any reduction in habitat components. However, the vegetation trends previously described would continue to cause a decline in the quality of mature, mixed conifer forest habitat for this species. Density-related tree mortality in the larger trees would be expected to continue. Remaining trees would remain growth suppressed, causing a further decline in the largest, most mature trees and a shift toward more seedlings and saplings. As the larger trees continue to die and fall prematurely, there would be a loss of large overstory canopy cover and a decline in the average tree sizes and ages. The imbalance of age diversity and a stand density index approaching or beyond the zone of imminent mortality threaten the vitality of the vegetative zone and its ecological dependents such as the MSO. Thus, the imbalance in proportions of small young trees to large mature trees would continue to be significant. In addition, the biggest threat to the MSO has been identified as catastrophic wildfire, and this would remain a major threat to the species under the No Action Alternative.

Alternative 2: Proposed Action

VEGETATION THINNING AND PRESCRIBED FIRE

MEXICAN SPOTTED OWL

Based on species sensitivities described in the 2012 MSO Recovery Plan (USFWS 2012), activities associated with the Proposed Action may affect MSO. Potential impacts include noise disturbance (e.g., operation of heavy machinery), removal of suitable nesting or perching trees or snags, and increased anthropogenic activity–related disturbance (e.g., increased vehicular traffic, human activity) (USFWS 2012). These disturbances have the potential to lead to change in MSO behavior or flush them from perches, daytime roots, and nests. MSOs are known to have high site fidelity in established territories, and short-term impacts may disrupt normal behavioral patterns, such as breeding, foraging, etc., and may not be avoidable. If disturbances and associated changes in behavior occur, this could lead to increased vulnerability to heat-related stress and predation, or lead to nest abandonment and reduced reproductive success (U.S. Forest Service 2022). However, impacts to MSO are dependent on context related to the presence of owls in the vicinity of project activities and MSO habitat type, as well as the duration, magnitude, location, and timing of treatment implementation.

Of the 7,185 acres of modeled recovery nest/roost habitat within the analysis area, approximately 31.1% (2,234 acres) are proposed for thinning and prescribed fire activities and an additional 27.7% (1,991 acres) are proposed for prescribed fire only; resulting in 58.8% of recovery nest/roost habitat which may be subject to treatments throughout the project timeline (see Figure 3.14).

Within the analysis area, there are 3,394 acres of previously mapped PACs (see Table 3.20). Each of the five previously identified PACs contain acreage proposed for thinning activities totaling approximately 792.8 acres (34.5% of PACs within the analysis area) and 2,023 acres of prescribed fire (approximately 59.6% of PACs within the analysis area) (U.S. Forest Service 2022). To maintain confidentiality of specific PAC locations, areas of PACs identified as meeting conditions for proposed treatments are not disclosed in this assessment.

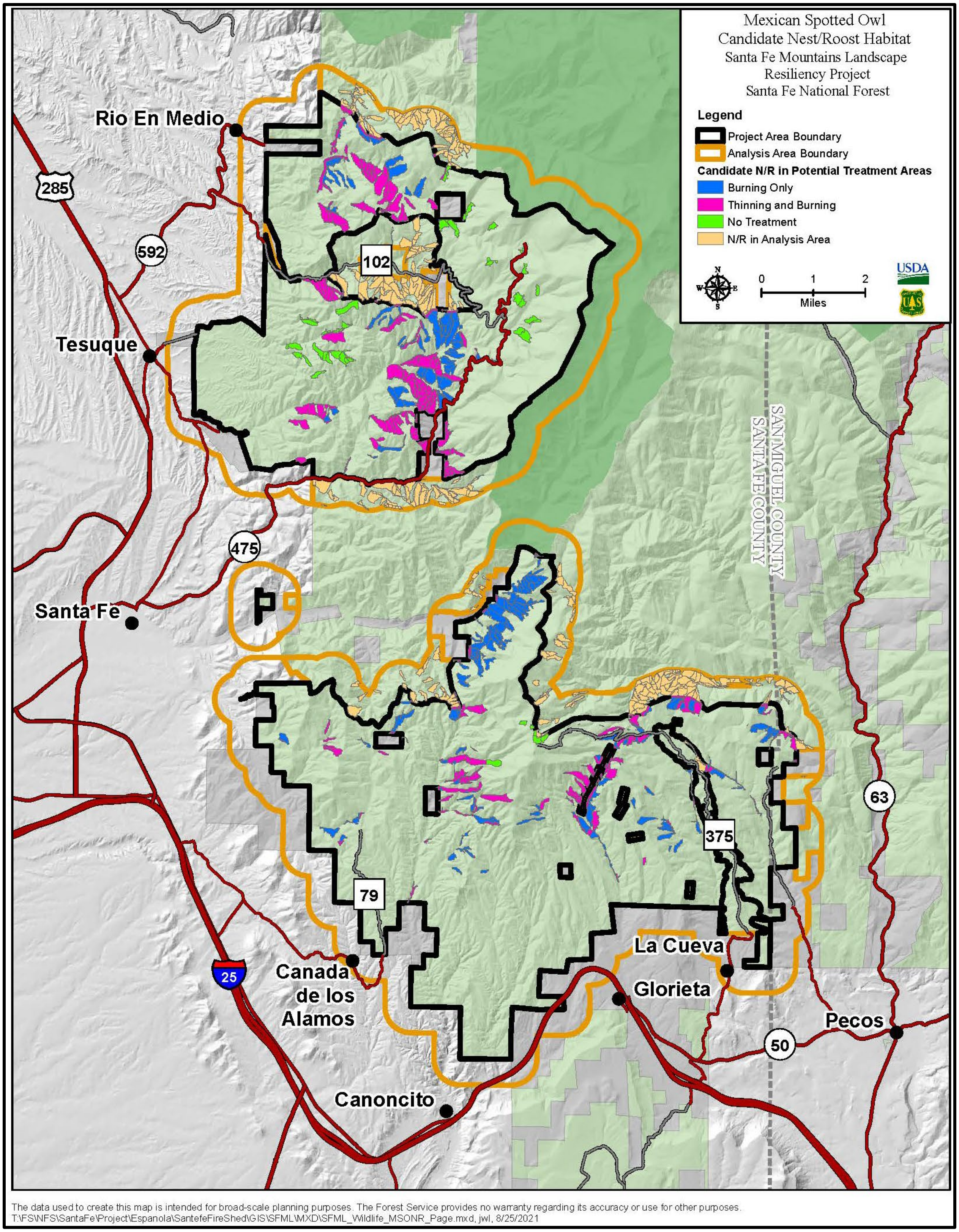


Figure 3.4. Map of project showing designated Mexican spotted owl recovery nest/roost habitat that may be affected by proposed thinning and/or burning.

The analysis area also includes 4,517 acres of USFWS-designated critical habitat (USFWS 2012; U.S. Forest Service 2022), of which 807 acres (17.8%) are estimated to be suitable for proposed thinning activities and 1,954 acres (43.2%) for proposed prescribed fire treatments. To evaluate the potential impacts to designated critical habitat for this species, detailed analysis of Proposed Action effect on Primary constituent elements (PCEs) that indicate desired conditions for forest structure and prey abundance for MSO critical habitat is included in the biological assessment on file with the USFWS (USFWS 2012; U.S. Forest Service 2022). Within these areas, vegetation thinning, and prescribed fire treatments would be implemented to achieve desired conditions specific to the habitat type according to the 2012 Recovery Plan and as outlined in Appendix A (USFWS 2012).

The conditions-based management approach would incorporate the use of the U.S. Forest Service Region 3 Mexican Spotted Owl Project Checklist to ensure consistency with the MSO Recovery Plan (see Section 2.2). MSO pre-implementation surveys and the appropriate treatment designs that target desired conditions for MSO (see Appendix A) and application of MSO-specific design features (MSO-1 through MSO-14; see Appendix C), would substantially reduce the likelihood and severity of adverse impacts to MSO (U.S. Forest Service 2022). In stands where the existing condition meets the desired habitat conditions, the area would either not be thinned or would be thinned only in a way that would not move the area below the habitat criteria. Assuming completion of the proposed project treatments, the U.S. Forest Service anticipates a long-term net beneficial impact to MSO populations and habitat due to the reduced risk of catastrophic wildfire and improved habitat conditions for MSO as described in Section 1.4.5.

Improving MSO habitat and reducing the risk of catastrophic wildfire are the primary objectives of the Proposed Action, and both are recommended management actions for MSO conservation and recovery (USFWS 2012, 2021c). However, the implementation of forest thinning and prescribed fire treatments could result in short-term habitat conditions that may adversely impact MSOs, including within PACs, as described above. Anticipated long-term beneficial impacts to MSO populations include an increase to the amount of available habitat that meets MSO-specific desired conditions for forest structure as well as reduced wildfire risk (U.S. Forest Service 2022).

In general, thinning activities within mixed conifer-frequent fire, ponderosa pine, pinyon-juniper woodland, pinyon-juniper grassland, and juniper grassland ERUs would occur in stands with existing conditions not considered high-quality habitat for nesting or roosting activities due to the high density of smaller trees. Due to project area topography, as well as application of project IDFs, the majority of thinning treatments would be done by hand and produce less noise disturbance than in areas where machinery is used for mastication, machine piling, and fireline installation.

Use of heavy machinery would be restricted to areas with slopes less than 40% (MSO-1 and MSO-2 in Appendix C), which greatly reduces the spatial extent of such treatments and the likelihood that mechanical thinning would occur in the high-quality MSO habitat under existing conditions (U.S. Forest Service 2022). In areas where mechanical thinning would occur, MSO habitat quality would be temporarily reduced where noise disturbance is above 68 decibels (USFWS 2012) equivalent to the duration of said noise levels with an immediate return to base level suitability following treatments.

Approximately 11% of the project area contains slopes greater than 60%, which are unsuitable for mechanical or hand thinning. An additional 32% of the project area contains slopes between 40% and 60%, where mechanical thinning would not occur, and thinning would be limited to the removal of smaller trees without heavy equipment (e.g., crews with chainsaws). The majority of suitable MSO habitat, including in PACs within the project area, occur on these steeper slopes and would either be left in their current condition, would be selectively thinned to remove trees less than 9 inches in diameter (dbh), or would be treated through low- to moderate-intensity prescribed fire. This spatial variation in project treatment activities as well as annual limits of treatment acreages would create a mosaic of habitat conditions throughout the project area and leave large areas of suitable habitat as it currently exists (U.S. Forest Service 2022). Where treatment areas would occur on operable slopes (i.e., <40 percent for mechanical thinning and <60 percent for hand thinning), the decision to implement thinning would be based on existing and desired vegetation conditions.

Mechanical thinning, hand thinning and the use of prescribed fire would remove shrubs and small trees, allowing for greater sunlight to the understory. Increased plant production and diversity would support an increased prey base for owl foraging and a long-term improvement of habitat conditions. Removal of some larger trees (>12 inches dbh) could have short-term impacts on MSO habitat until remaining trees grow larger. Suitable nest trees and prey habitat may be lost by removing a lot of large trees; however, as large trees would only be removed under the appropriate seasonal conditions, with design to meet habitat specific desired conditions and with implementation of design features (MSO-1 through MSO-14), the treatments are not anticipated to significantly reduce the availability of suitable nesting trees or prey habitat or affect reproduction efforts.

Additionally, the conditions under which prescribed fire would be used to treat stands toward desired conditions would be when fuels and climatic conditions are expected to produce low to moderate fire intensity with flames mostly limited to the ground level and well below the canopy of larger trees where MSOs prefer to roost (U.S. Forest Service 2022). Therefore, no direct removal of active or inactive MSO nests is anticipated to occur as a result of prescribed fire treatments. If weather and fuel conditions are appropriate for spring burning, the potential risk of disturbing nesting MSOs would be mitigated by survey requirements prior to treatments (MSO-13 and MSO-14) and associated project IDFs (MSO-3 through MSO-12), which would ensure appropriate avoidance of occupied habitat (U.S. Forest Service 2022). Fire operations may include the use of multiple vehicles, hand crews, and aircraft (such as helicopters) being used for aerial ignition across several hundred acres, resulting in increased noise above baseline levels. The resulting noise and activity could disturb owls if thresholds are above tolerance and lead to behavioral changes and temporary reduction in habitat suitability related to temporary displacement. Additional short-term adverse impacts may result from reduction of canopy cover in stands with a high density of smaller trees including displacement of small mammal prey species (U.S. Forest Service 2022). The impacts of such activities would depend on site-specific habitat conditions and use by MSOs at the time of treatment.

Overall, the Proposed Action is anticipated to improve conditions in MSO habitat by retaining the largest trees and desired forest composition and structure, maintaining important habitat features such as snags and large downed logs, and using prescribed fire to reduce high fuel loads and promote herbaceous vegetation (U.S. Forest Service 2022). It is likely that the Proposed Action activities would have short-term adverse impacts on habitat on small spatial scales (e.g., logs that currently provide small mammal habitat may burn), but these effects will be mitigated by the long-term application of treatments, as well as species-specific IDFs. The implementation of the Proposed Action would greatly reduce the likelihood of high-severity fire effects across the broader forest landscape and help protect MSO PACs, critical habitat, and recovery nest/roost habitat from future stand-replacing wildland fires, as well as enhance landscape-level forest resiliency to climate variability resulting in a long-term beneficial impact to the MSO population of the Santa Fe National Forest.

HOLY GHOST IPOMOPSIS

Within the portion of the Glorieta Creek-Pecos River watershed within the SFMLRP area, there are approximately 27 acres of potentially suitable HGI habitat, based on the best available habitat modeling (U.S. Forest Service 2022). The suitable habitat is considered marginal based on habitat conditions of known populations and is located greater than 4.5 miles from the nearest known occurrence of the species. However, as the 27 acres identified as potentially suitable HGI habitat may be subject to the condition-based management approach which includes coordination with resources specialists and applicable partnering agencies to determine the appropriate design features and mitigation measures necessary to implement proposed treatments without previously approved adverse effects to threatened and endangered species would apply. This process could include identification of necessary measures such as pre-treatment biological surveys and flagging and avoidance of occupied habitat if found to be present (Appendix C, Plant-8). Pre-treatment coordination and evaluation of suitable habitat ensure that HGI populations would not be removed or adversely affected as a result of proposed activities. Additionally, as detailed in the biological assessment (U.S. Forest Service 2022), the existing conditions within the 27 acres of identified suitable habitat does not coincide with the conditions guiding thinning treatments or prescribed fire fuel breaks and is therefore unlikely to be selected for said treatments. Therefore, the proposed project is not expected to adversely impact HGI.

RIPARIAN RESTORATION

Proposed riparian restoration activities are designed to improve degraded streamside conditions and occur within parts of two previously identified MSO PACs. These proposed activities would include removal of trees not considered to be components of high-quality riparian forest habitats, including native conifers as well as a variety of non-native invasive species. In general, MSOs are not present in riparian areas during the day, so it is unlikely that implementing the vegetation removal and planting would have direct adverse impacts to MSO (U.S. Forest Service 2022). In general, MSO and other wildlife species are anticipated to benefit from the increase of availability of functioning riparian corridors and related ecosystem functionality including an increase in habitat for preferred prey species (see Section 3.7 for additional information related to impacts to riparian resources). Additionally, any activities within PACs would follow Recovery Plan guidance and design features MSO-1 through MSO-14 (see Appendix C) to avoid disturbing MSO or damaging suitable habitat.

ROAD CLOSURE

The proposed road closure action is not anticipated to affect the MSO or its habitat.

Cumulative Effects

See Table 3.1 for a list of present and reasonably foreseeable future actions considered for cumulative effects on threatened and endangered species. Spatial and temporal boundaries for cumulative impacts analysis are the same as described above.

Ongoing and planned fuel reduction projects would continue to occur on adjacent tribal lands and other federal, state, and private lands surrounding the project area. All previously authorized federal actions have been analyzed for MSO and have been consulted on with the USFWS as applicable, and future projects would also be subject to ESA consultation.

Restoration activities would occur on adjacent public lands, including, but not limited to, the Pacheco Canyon Forest Resilience Project, La Cueva Fuel Break Project, County Line Fuel wood Treatments, Southern Rowe Mesa Restoration Project, Hyde Park Wildland Urban Interface Project, Santa Fe Municipal Watershed Project, Santa Fe Municipal Watershed Pecos Wilderness Prescribed Burn Project, Aztec Springs, Phase 2 & 3, Aspen Ranch (Pueblo of Tesuque), Vigil Grant (Pueblo of Tesuque), the Hyde Memorial State Park (New Mexico State Forestry) project would also increase ecosystem resilience in the analysis area. Combined, these projects would treat up to approximately 34,296 acres over the next decade. These projects along with the Proposed Action are anticipated to move ecosystems within the analysis area toward desired conditions including improved wildlife habitat. This would result in long-term beneficial impacts for threatened and endangered species, including MSO by increasing available suitable habitat and creating additional resilience across the forest against catastrophic wildfire. However, short-term adverse impacts may occur including temporary, localized disturbance of wildlife species and their prey species during treatment activities.

Additionally, other non-forest restoration actions within the analysis area including the issuance of Forest-wide temporary and priority special use permits (SUPs) for non-motorized over-snow activities, Pecos Bike Trails, Santa Fe River Greenway Recreation and Public Purpose Act (R&PP) Lease Project, may also have cumulative impacts to MSO when combined with the Proposed Action. These actions would contribute to an increased human and vehicle presence within MSO habitat areas. However, related impacts are expected to be minimal and temporary in nature and mitigated through the application of design features, and therefore not expected to lead to permanent or significant impacts to MSO or it's critical habitat.

Overall, the cumulative impacts of these actions when added to the impacts of the Proposed Action would create a synergistic effect with respect to reducing risk of severe and uncharacteristic fire upon the landscape and WUIs and in turn protect threatened and endangered species habitat across the forest.

Summary

The 2022 Forest Plan and Recovery Plan provide implementation guidance to avoid or reduce potential effects on MSO, designated CH and forest conditions that contribute to conservation and recovery of the species. The project-level IDFs provide further guidance for avoiding direct and indirect adverse impacts to MSO. Overall, potential affects to MSO are expected to be insignificant and discountable, whereas there will be substantial benefits to forest conditions resulting from project implementation.

The 2012 Recovery Plan identified catastrophic wildfire as one of the most significant threats to MSO. By reducing fuels through thinning and prescribed fire, and by generating patchy fuel conditions across the project area, implementation of this project is expected to decrease the risk of catastrophic wildfire compared to the No Action Alternative.

Thinning and prescribed fire activities in PACs may result in minor disturbance to owls during the non-breeding season. However, most of these actions would be implemented where owls are not present and implementation within PACs would follow design features to avoid harm or harassment of MSOs. This project may also have some potential short-term negative effects on potential MSO habitat resulting in beneficial long-term effects (e.g., disturbance associated with thinning dense stands of small trees to promote desired conditions of vegetation structure and reduced wildfire risk). However, these effects would only occur in areas with sub-optimal forest structure, so there would be no reduction in the area or quality of MSO habitat within PACs that meets the desired conditions in the 2012 Recovery Plan. Based upon the analysis of the proposed activities within the project and analysis area, which are consistent with the forest plan, the 2012 MSO Recovery Plan and all project IDFs, implementation of the project **may affect, but is not likely to adversely affect** the MSO (U.S. Forest Service 2022).

Critical Habitat is designated within the project and analysis area, including areas where activities are proposed. All Recovery Plan guidance regarding critical habitat management would be followed to maintain existing PCEs and improve conditions for MSO. The Proposed Action is likely to have some short-term effects on PCEs (e.g., temporary habitat disturbance from prescribed fire or thinning), but the activities would produce long-term beneficial effects on PCEs through promoting desired habitat conditions for MSO and reducing the risk of catastrophic wildfire (U.S. Forest Service 2022). Therefore, the project **may affect, but is not likely to adversely affect** MSO critical habitat (U.S. Forest Service 2022).

The effects on recovery nest/roost habitat of the proposed activities were analyzed, and nest/roost habitat was designated for this project to comply with the 2012 Recovery Plan. Recovery nest/roost habitat is, by definition, unoccupied by MSO, and potential disturbance activities would be preceded by owl surveys, so direct effects on MSO from project implementation in these areas is very unlikely. Indirect effects through habitat alteration are possible, but such an analysis would be speculative given the uncertainty of where and when MSO may establish nesting or roosting sites. Overall, the project is expected to improve forest composition and structure in recovery habitats (both nest/roost and foraging/dispersal) and reduce the risk of catastrophic wildfire. By managing for the desired conditions described in the 2012 Recovery Plan and following implementation guidance to avoid departure from those conditions where they already occur, this project contributes to the SFNF's commitment to support MSO conservation and recovery.

Through the conditions-based approach, each treatment unit would be assessed to determine if suitable HGI habitat exists and if so, what may be necessary to protect HGI if it were to occur in the unit. Considering that the HGI is not known to occur in the area and would be protected if discovered, then implementation of the project is expected to have **No Effect** on HGI (U.S. Forest Service 2022).

3.5 Flora and Fauna

The focus of this section is to analyze the following questions:

Is the proposed project consistent with 2022 Forest Plan components that are associated with species of conservation concern (SCC)?

Is the proposed project compliant with the Migratory Bird Treaty Act (MBTA) and Bald and Golden Eagle Protection Act?

What are effects to general wildlife habitat as a result of the Proposed Action?

3.5.1 Affected Environment

Treatments are proposed only within the mixed conifer-frequent fire forest, ponderosa pine forest, pinyon-juniper woodland/grassland and narrowleaf cottonwood / shrub ERUs (see Table 2.3). During the project review process, U.S. Forest Service biologists reviewed existing information including spatial data and FS and state databases to identify species occurrence, existing habitat, and vegetation cover models as well as other life history and habitat requirements for species that may occur in the project area.

At-Risk Species

At-risk species identified for the Santa Fe Forest Plan revision include federally classified endangered, threatened, proposed, and candidate species, as described under the ESA (1973), and species of conservation concern (SCC) (USDA FS Santa Fe NF 2022). SCC are species, other than federally recognized species, that are known or expected to occur on the Santa Fe NF and for which the Regional Forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long term. For SCC, habitat management and compatible multiple uses will be accomplished in a way that ensures species' persistence on the Santa Fe NF, in accordance with the 2012 Planning Rule (36 CFR § 219.9(b)). The expectation is that if a project is consistent with 2022 LMP direction that population viability for SCC will be maintained. This process replaces previous Forest Service Manual 2670 Direction for Regional Forester Sensitive Species and Management Indicator Species analyses, which no longer apply. (36 CFR 219.9(b)).

Analysis of biological resource data, including habitat assessment and field reconnaissance, determined that the following twelve SCC species may occur or have suitable habitat within the project area; Pacific marten, Gunnison's mariposa lily, Lewis's woodpecker, wood lily, Pinyon jay, American peregrine falcon (foraging habitat), Greene's milkweed, large yellow lady's slipper, masked shrew, northern goshawk, northern leopard frog and water shrew. These species were evaluated for forest plan compliance, specifically for Standards (S), Guidelines (G) and Desired Condition (DC). Twenty-one SCC species, including one Federal Candidate species (Rio Grande cutthroat trout), were not considered for further plan compliance based on lack of suitable habitat or occurrence (USDA Santa Fe NF 2022).

For more information on 2022 Forest Plan standards, guidelines, desired conditions and project specific design features or mitigation measures as they relate to the project, refer to Appendix B, SCC Report.

General Habitat

The vegetation within the analysis area consists of a high diversity of ERUs in variable states of meeting desired conditions. These include mixed conifer and aspen overstory types as well as understory types of upland vegetation such as grasses and small shrub dominant vegetation. The vegetation cover primarily consists of uneven-aged tree stands with generally open canopy. Within the analysis area, there are pockets of denser stands dominated by fir species (Douglas [*Pseudotsuga menziesii*] and white [*Abies concolor*]), spruce species, oak species, with higher concentrations of forb and grass ground cover. Additionally, the project area contains some limited riparian vegetation corridors (see Section 3.7) dominated by willows, alders, cottonwoods, sedges, rushes, grasses and forb species. Table 3.21 provides detailed quantification of the present ERUs in the project area as compared to the entire Santa Fe National Forest to allow for a comparison of project area vegetation composition to the greater availability of habitat within the vicinity.

Table 3.20. . ERUs, Associated Seral and Climax Species, and Approximate Acreage in the Project Area

ERU*	ERUs in SFNF (acres)	Project Area (acres)	Analysis Area (acres)	Project ERU (% of ERU across the SFNF)
Mixed Conifer–Frequent Fire Forest	429,967	17,875	25,945	4
Ponderosa Pine Forest	403,915	17,347	23,094	4
Pinyon-Juniper Woodland, Pinyon-Juniper Grassland, and Juniper Grasslands	274,864	8,660	12,091	3
Spruce-Fir	250,481	5,022	8,484	2
Riparian: primarily Narrowleaf Cottonwood/Shrub	45,993	680	1,332	1
Montane/Subalpine Grassland	17,707	491	497	3
Mixed Conifer with Aspen	40,174	456	763	1
Colorado Plateau/Great Basin Grassland	41,639	139	412	3
Other (Alpine and Tundra)	5,015	63	8,043	2
Total	**1,509,755**	**50,556**	**80,661**	

* Bolded text indicates those ERUs proposed for treatment, as described in Chapter 2.

The general desired condition for general wildlife is a resilient forest ecosystem with a mosaic of site-appropriate vegetation types consisting of a diversity of vegetation species, sizes, age classes, densities, and distributions, which provides an array of habitat for the species within the analysis area. Existing conditions in ERUs identified for treatment are characterized by single aged stands with conditions of high risk to catastrophic wildlife. Such conditions result in a proportional risk of significant adverse impacts to general wildlife species including mortality, long-term displacement, reduction of available habitat, and other indirect impact to behavior.

Migratory Birds

The primary direction for the management of migratory birds on National Forest System lands is contained within the Migratory Bird Treaty Act (MBTA) of 1918, the 2001 Executive Order (EO) 13186, and the 2008 *Memorandum of Understanding between the USDA Forest Service and the US Fish and Wildlife Service to Promote the Conservation of Migratory Birds* (MOU). The Executive Order directs federal agencies to avoid or minimize the negative impact of their actions on migratory birds, and to take active steps to protect birds and their habitat. The U.S. Forest Service's Southwest Region (R3) currently analyzes impacts to migratory birds by addressing the following: 1) effects on high-priority birds categorized as "Species Conservation Level 1" as identified by New Mexico Avian Conservation Partners (2013), 2) effects on Important Bird Areas (IBAs), and 3) effects on Overwintering Areas.

Species that are known to occur or have suitable habitat within the analysis area are included in Table 3.22. There are no designated Important Bird Areas within the analysis area and no further analysis is included. Additionally, overwintering areas in New Mexico consist primarily of large wetlands or other water sources. Important overwintering areas recognized on the Forest include the Pecos River, and Rio Chama and Rio Grande corridors, all of which are outside of the analysis area. Therefore, no further analysis of impacts to overwintering areas is included in this analysis.

Table 3.22. Migratory Bird Species Conservation Level 1 within the Project Area

Veg type	Species	Habitat	Potential Project Impacts	Disturbance Effects
Pinyon-Juniper Woodland, Pinyon-Juniper Grassland, and Juniper Grasslands	Black-throated gray warbler	Piñon juniper, mostly in piñon for nesting. Habitat quality was reduced due to high piñon mortality from beetle kill and drought.	New and young trees would remain available. Trees and stands would be healthier over the long term.	See discussion. Temporary during implementation. No direct disturbance if activities take place outside of. breeding season. Nests would be protected or not actively removed/ damaged. Existing nests may be lost outside of breeding season.
	Gray vireo	Juniper, pinyon pine, and oak open savannas to slightly more closed-canopy woodlands.	Project is largely above the elevational range. Leave-islands and thinned areas would provide a diversity of open- and closed-canopy forests.	
Ponderosa pine forest	Flammulated owl	Large snags in or near open areas. Low number of snags in area but they would not be targeted for removal.	Snags would be protected per direction except for hazard trees. New snags may be created through Rx burns.	
	Virginia's warbler	Nests on ground in a variety of understory	Oak, small trees, shrubs, brush and grasses would	

	species and high litter cover. Gambel's oak shrub preferred.	benefit from a more open understory. Heterogeneity would provide for a variety of vegetation and litter cover quantities.
Grace's warbler	Pine specialist. Gleans insects from large trees. Prefers open forest with mature, tall trees.	Mature/large trees would be retained, especially pines, and would benefit from decreased competition. Reduction in smaller trees meets open forest preference. Heterogeneity would provide for a variety of vegetation types, tree densities and foraging opportunities.

NMACP (formerly New Mexico Partners in Flight) considers eight risk factors in identifying conservation priority species: 1) Breeding Distribution, 2) Non-breeding Distribution, 3) Breeding Season Threats, 4) Non-breeding Season Threats, 5) Breeding Season Threats in New Mexico, 6) Importance of New Mexico to Breeding, 7) Population Size, and 8) Local Population Size. Species with the highest risk factors are classified as "Species Conservation Level 1" (SC1). This evaluation addresses general effects to migratory birds and specific effects to SC1 species for the main habitat types found in the project area.

Species with the highest risk factors are classified as “highest priority” for conservation action. This evaluation addresses general effects to migratory birds. Specific effects to highest priority species for the main habitats are found in Table 16, which displays habitats and species that may occur in the Project area. Habitats used by migratory birds range widely from early to late successional stages, from prairie to forest. Migratory birds use these areas for feeding, roosting, and nesting. The project area contains largely mixed conifer and ponderosa pine forest with an understory of seedlings/saplings and pole-sized white fir and Douglas fir, with brush species such as Mountain mahogany and shrubby Gambel oak and pinon-juniper in the lower elevations.

Woody material in the form of fallen trees and large limbs is present throughout the area. Under the Proposed Action, smaller woody material would be consumed during burning which may provide habitat improvement by increasing understory vegetation growth, thus providing increases in foraging opportunities for birds that feed on seeds and insects. Some larger woody material would be consumed during burning but would likely be replaced as some larger trees die and snags fall, either through natural processes or as a result of burning. The creation of snags would provide and increase in insects and cavities for nests. Treatments would benefit specific migratory birds by creating habitat for open-forest species without eliminating habitat for closed-forest species. Thinning and burning treatments would increase forest heterogeneity thus species richness, which benefits many species, including forest bird diversity, by reducing canopy cover, encouraging herbaceous ground cover, limiting ladder fuel species, and encouraging shrub diversity in canopy openings, while also maintaining areas of dense forest stands on the landscape (Latif, et.al. 2020).

Reduction in canopy cover would occur in many of the treatment areas but would be mixed with untreated areas (such as leave-islands) and areas where treatments would not remove trees contributing to canopy cover. These treatments would maintain large, mature trees. Consequently, treatments would continue to provide habitat for migratory species such as Plumbeous Vireo, Pygmy Nuthatch, and White-breasted Nuthatch (Latif and Pavlacky 2020). Treatments would specifically reduce sapling and smaller trees, resulting in less dense, more open stands, while maintaining large, mature trees individually, in clumps or in stands, such as leave-islands. This heterogeneity may provide benefits to species such as Western Bluebird, Dark-eyed Junco, Mountain Chickadee, White-breasted Nuthatch, Pygmy Nuthatch, Brown Creeper, and Western Wood-Pewee (Latif and Pavlacky 2020).

Impacts from noise and visual disturbance would occur but are expected to be temporary as implementation occurs across the project area, providing refugia away from the treatment areas. Impacts would be minimized further if treatments occur largely outside of the breeding season, whenever possible. Treatments are expected to promote habitat diversity and reduction of risk of habitat loss from catastrophic wildfire in the long term.

Range-wide concerns relating to high priority species stem primarily from potential loss of snags, effects of fire suppression, and effects from commercial thinning (logging). No commercial logging is proposed for the project. Proposed thinning would not remove snags or large trees except for safety hazards. Snags would likely be created by the proposed prescribed burning. Thinning would enable prescribed fire to maintain the ecological processes as part of this landscape.

Any avian nests discovered during project implementation would be avoided and left in place (IDF- Wild 23-26). Additionally, IDFs recommend protections for habitat features such as snags, logs and habitat diversity. Implementation is likely to occur largely outside of the breeding season, however, it may occur during breeding season and therefore may directly affect birds through disturbance, mortality or damage of nests. Prescribed burning may damage some nests or nest trees/bushes/shrubs in the area; however, nests would not be targeted for removal and nests would remain unharmed by project treatments in the surrounding landscape and within non-treatment areas (leave-islands and other untreated areas) within the project, therefore continuing to provide sufficient opportunities for migratory birds to maintain their population viability.

No significant negative effects are expected to migratory bird species and the proposed action would improve habitat conditions over the long term by restoring ecological diversity of vegetation composition and structure by reducing the number of trees per acre, promoting variable age class structure. Potential negative impacts would be of short duration and across relatively small areas each year. Treatments would be designed and planned with consideration for breeding birds to minimize the potential for cumulative effects. For example, if work were to occur during the breeding season, depending on the species and vegetation types, strategic planning could allow for treatments to occur in a staggered manner, such as treating less than 1/3 of the National Forest System Lands in each specific HUC 12 watershed in a given year, thus leaving at least 2/3 of the area as refugia for nesting and recruitment. Executive Order 13186 requires the disclosure of unintentional take reasonably attributable to proposed actions that could have a negative effect on migratory bird populations, with emphasis on priority species. Unintentional (i.e., that is not the purpose of the activity) take (i.e. killing of birds, young, or eggs) is not prohibited under the act or executive order. Disturbance, disruption or the modification of habitat is not considered as unintentional take under the MBTA and MOU. This project may unintentionally result in take, such as if a nest of eggs is not known and burns during prescribed fire, however the risk of take is minimized through the implementation of IDFs, such as implementing outside of the breeding season when possible, avoiding nests when observed and by not treating the entire project or entire watersheds at once.

Bald and Golden Eagles

Golden and bald eagles are protected under the Bald and Golden Eagle Protection Act. Under this Act, take is defined as to " … pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest or disturb." Disturb is further defined as " … to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available: (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." Bald and golden eagles are also protected under the Migratory Bird Treaty Act, which also prohibits take.

Bald eagles (*Haliaeetus leucocephalus*) are found typically in association with water and nest and breed from October to July throughout the state of New Mexico. Golden eagles nest primarily on rock ledges or cliffs and occasionally in large trees at elevations ranging from 4,000 to 10,000 feet amsl. Golden eagles (*Aquila chrysaetos*) are typically found in mountainous regions of open country, prairies, arctic and alpine tundra, open wooded areas, and barren areas. Both bald and golden eagles are carnivores. Bald eagles prey on fish but also on mammals, especially prairie dogs (Cynomys sp.). Golden eagles feed mainly on small mammals, as well as invertebrates, carrion, and other wildlife (BISON-M 2021; Stahlecker and Walker 2010).

Bald eagles are not known to occur in the project area or in surrounding areas. The project area lacks suitable habitat such as bodies of water with fish or waterfowl. While the analysis area contains some reservoirs, they are not close enough for nesting to occur in the project area. Additionally, there are no wetlands or playas within the analysis area which would provide prime foraging habitat. Golden eagles may occur due to the availability of mountainous habitat and availability of prey species within grasslands portion of the analysis area.

3.5.2 Environmental Consequences

Methods and Assumptions Used for Analysis

The following analysis methodologies and assumption were used to consider potential direct, indirect, and cumulative effects on migratory birds, bald and golden eagles that have potential to or are known to occur within the analysis area. The analysis area for all of the following subsections is defined by the project area plus a 0.5-mile buffer to account for areas subject to indirect effects of the Proposed Action (see Figure 3.15).The analysis area is approximately 64,782 acres of land managed by the U.S. Forest Service.

For the analysis of direct and indirect effects, short-term impacts are impacts lasting up to 2 years from when the action was implemented, and long-term impacts are impacts lasting longer than 2 years.

Assumptions:

- Restoration activities would be implemented in a phased approach over a 10- to 15-year period and distributed across the project area.
- Implementation of proposed vegetation treatments would occur on up to 750 acres for vegetation thinning and up to 4,000 acres for prescribed fire, annually.
- Spatial arrangement and timing of proposed activities within goshawk habitat will be conditions-based with treatment designed to meet goshawk-specific desired conditions.
- Individual vegetation thinning treatment units would vary according to the size and arrangement of appropriate stands on the landscape. In general, stands thinned in a year would be individually smaller than the total acreage thinned that year and discontinuous in spatial arrangement (e.g., multiple separate areas of tens to hundreds of acres each with leave areas within the treatment boundaries due to sensitive resources or steep slopes).
- The prescribed fire treatment units would average 500 to 1,000 acres in size and burning would be done primarily in the fall. Fire intensity would be patchy within the burn unit boundaries, including some unburned refugia.
- All IDFs (design features, mitigation measures, and best management practices), including species specific measures Wild-1 through Wild-26, MSO-1 through MSO-14 and NOGO-1 through NOGO-13 (detailed in Appendix C), would be implemented as applicable to treatment area conditions and present species habitat.
- Pre-treatment surveys and habitat identification would be conducted according to the MBTA (Wild 23- Wild 26).

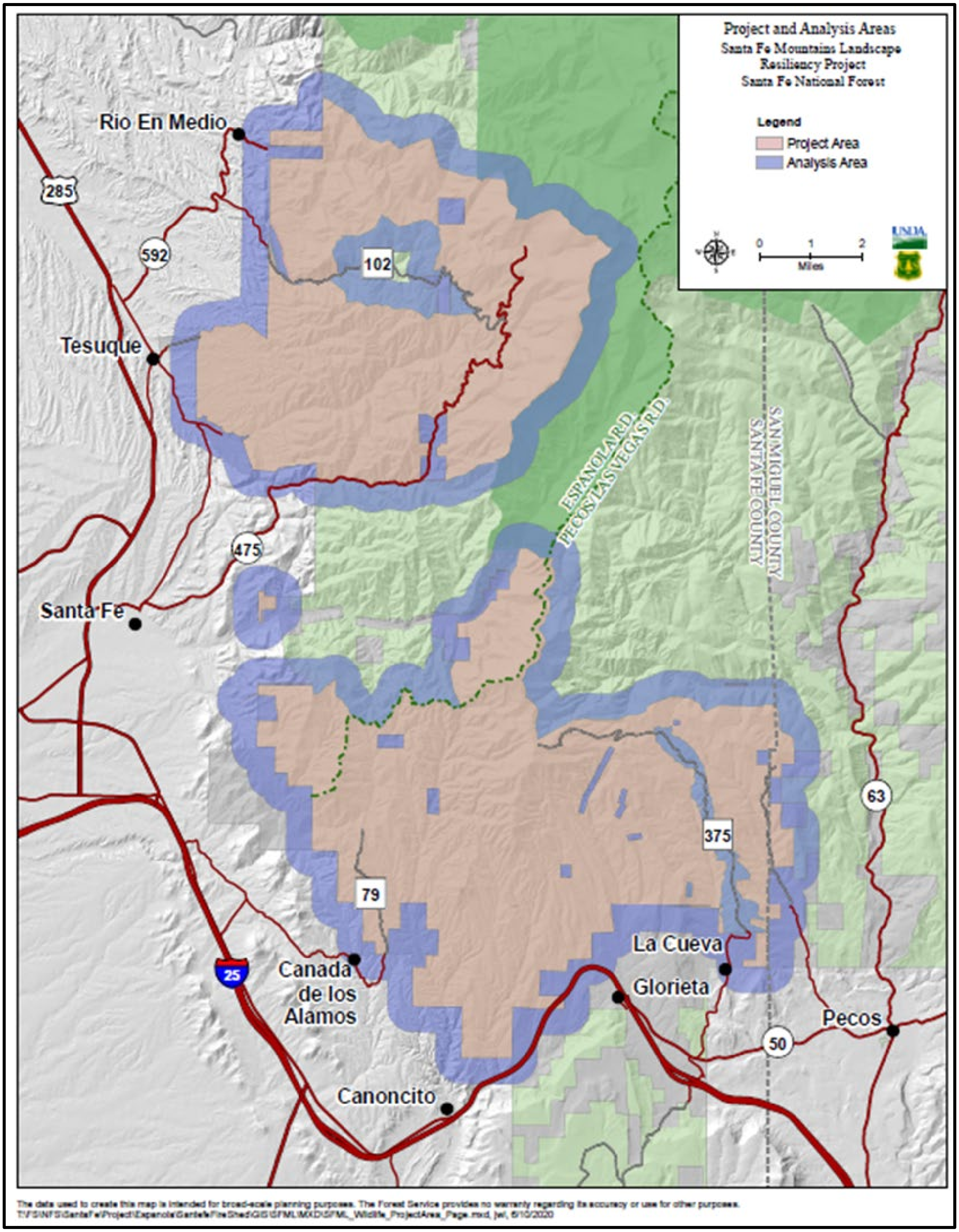


Figure 3.15. Map of the flora and fauna analysis area.

Alternative 1: No Action Alternative

GENERAL WILDLIFE HABITAT

The No Action Alternative represents a continuation of the current conditions and trends. Vegetation would continue on the current trajectories, generally becoming denser. Wildfire risk would continue to increase over time (see Section 3.3) with the consequence that large areas of suitable habitat for wildlife species could burn at high severity during a wildfire, removing and reducing habitat availability, in both the short-term and long-term. Impacts to most species could include total loss of key habitat components (nest/roost/den/reproductive sites, increased sedimentation of streams, loss of prey habitat, etc.). Conversely, wildfire events could provide some benefits to species such as woodpeckers and other fire-adapted species. Large, high-intensity wildfire could change stand composition and effectively change the distribution of wildlife species in the analysis area.

The No Action Alternative would not move the project area toward desired conditions which would likely lead to further decline in suitability for wildlife habitat by increasing risk of high intensity fire events. The No Action Alternative would also continue to promote habitats that become more homogenous over time and are less resilient to disturbance and drought due to the lack of variation and the increased competition for resources and susceptibility to insect and disease encroachment due to overstocking. Less resilient habitats are more at risk to large scale catastrophic events that can remove large areas of habitats.

MIGRATORY BIRD TREATY ACT AND BALD AND GOLDEN PROTECTION ACT

As stated previously, the No Action alternative would leave the landscape in existing condition and may lead to further decline in suitability for wildlife (migratory bird and eagle) habitat by increasing risk of high intensity fire events. The No Action Alternative does not propose necessary treatments needed for sustaining or enhancing habitat (e.g., grasslands and forest openings) used for foraging and nesting and would continue to be lost due to encroachment by shrubs and trees. Risk of stand-replacing wildfire and proportional loss of habitat is increased under the No Action Alternative compared with the Proposed Action.

Alternative 2: Proposed Action

GENERAL WILDLIFE HABITAT

As the proposed project utilizes a conditions-based approach for treatment implementation, analysis of site-specific conditions and impacts to wildlife communities is not feasible. Therefore, impacts related to components of the Proposed Action consider implementation of treatments across the 15–20 year project timeline, and that not every acre of the proposed acres is likely to be treated due to factors including slope conditions, vegetation condition meeting desired conditions, presence of heritage sites, and avoidance of areas related to IDFs. With these considerations, impacts to analyzed flora and fauna are also likely to be distributed over the project timeframe and are expected to be less intensive than the maximum impacts disclosed in this analysis. As such, discussion of acreages and effects should be understood to be approximations to inform the project decision.

VEGETATION THINNING AND PRESCRIBED FIRE

Proposed thinning and prescribed fire treatments are expected to have a stimulating effect on the herbaceous understory by opening the canopy cover and allowing additional light to reach lower levels of the forest; thereby reducing competition for resources amongst the vegetation community. Prescribed burning would also reduce woody debris and recycle nutrients into the soil increasing availability for utilization by various plant species. In reducing competition, this would allow for increase tree growth and succession towards a diversified age class composition. This would create more forage in the form of grasses, leaves, flowers and seeds for small mammal species, insects, reptiles, songbirds and large mammals . Higher quantities and quality of forage would be a long-term beneficial impact to present wildlife species any may increase variety of present species and population sizes.

Implementation of the proposed project may lead to short-term adverse impacts to wildlife species within acres treated with prescribed fire. Herbaceous cover immediately following burning would be limited and therefore a temporary reduction available for small mammals until vegetation regrowth occurs. This would make small mammals more susceptible to predation and reduce overall foraging habitat. As small mammals would be more visible in these areas, there may be an associated benefit to predatory species such as MSO and other raptors. Following regrowth of herbaceous vegetation, it is expected small mammal populations would increase due to increase forage and vegetative cover as compared to existing conditions within the analysis area.

RIPARIAN RESTORATION

Riparian vegetation would not be removed by this project. Riparian restoration actions such as thinning, prescribed fire, and conifer removal are unlikely to have short-term direct adverse impacts to general wildlife species. Long-term indirect effects of site rehabilitation and riparian habitat improvement would be beneficial to species that utilize riparian corridors by improving watershed and hydrologic function, encouraging growth of cottonwoods, willows, and alders, increasing riparian vegetation diversity, and reducing the risk of catastrophic wildfire which would improve the resistance and resiliency of riparian areas to the adverse impacts of drought and conifer encroachment.

ROAD CLOSURE

No adverse of beneficial impacts to general wildlife are anticipated by the road closure component of the Proposed Action.

MIGRATORY BIRD TREATY ACT

ALL PROPOSED PROJECT ACTIONS

Habitats used by migratory birds are highly variable from early to late successional stages, from prairie to forest. Migratory birds use these areas for foraging, roosting, and nesting. The project area provides habitat components used by some migratory birds.

Woody material in the form of fallen trees and large limbs is present throughout the project area. Under the Proposed Action, migratory bird species are likely to be beneficially impacted in the long term by movement of ERUs towards desired conditions proportional to the reduced risk of wildfire and improvement in habitat diversity.

Smaller woody material would be consumed during prescribed fire treatments which would provide an improvement by allowing understory vegetation growth, thus providing increases in foraging opportunities for birds that feed on seeds and insects. Some larger woody material may be consumed during burning but would likely be replaced as some larger trees die and snags fall, either through natural processes or as a result of burning. The creation of snags is likely to provide an increase in insects populations and available cavities for nests.

Impacts from noise and visual disturbance would occur as a result of the Proposed Action but would be temporary and in relatively short duration as work moves across the landscape during the 15- to 20-year project timeline. Staggered implementation of proposed activities allows species to seek refuge away from the treatment areas in adjacent suitable habitat. Impacts would be minimized further by treatments occurring largely outside of the migratory bird breeding season. Migratory bird habitat would either benefit or be subject to neutral impacts to species using the area, as the treatments are expected to promote habitat diversity and reduction of risk of habitat loss from catastrophic wildfire.

Range-wide concern for high-priority species stem mostly from possible loss of snags, and the effects on habitat from fire suppression, or effects of commercial thinning (logging). Thinning within the Proposed Action would not remove snags or large trees except for rare cases where they present a direct hazard to workers in the area or restrict equipment movement in a way to cause a safety hazard. Snags would likely be created by the proposed prescribed burning. Thinning would enable prescribed fire to maintain the ecological processes as part of this landscape, thereby improving migratory bird habitat.

Individual nests or specific nesting areas are not known in the project area, although some are likely to occur. According to the IDFs that would be implemented as part of the Proposed Action, if a nest is discovered during thinning, it would be avoided and left in place (IDF- Wild 23-26). Additionally, IDFs recommend protections for habitat features such as snags, logs, and diversity. Implementation is likely to occur largely outside of the breeding season, however, it may occur during breeding season and therefore may directly affect birds through disturbance, mortality, or damage of nests. Prescribed burning may damage some nests or nest trees/bushes/shrubs in the treatment area, however, nests would not be targeted for removal and nests would remain unharmed by project treatments in the surrounding landscape and within non-treatment areas (leave-islands and other untreated areas) within the project, therefore continuing to provide sufficient opportunities for migratory birds to maintain their current populations and trends.

No substantial adverse impacts are expected to occur to migratory birds, and the Proposed Action would improve habitat conditions over the long term by restoring ecological diversity of vegetation composition and structure by reducing the number of TPA, promoting variable age class structure. Potential negative impacts would be of short duration and across relatively small areas each year, not all at once.

Executive Order 13186 requires the disclosure of unintentional take reasonably attributable to proposed actions that could have a negative effect on migratory bird populations, with emphasis on priority species. Unintentional (i.e., that is not the purpose of the activity) take (i.e., killing of birds, young, or eggs) is not prohibited under the act or executive order. Disturbance, disruption or the modification of habitat is not considered as unintentional take under the MBTA and Memorandum of Understanding.

BALD AND GOLDEN PROTECTION ACT

The Proposed Action could result in short-term adverse impacts to golden eagles in the form of habitat disturbance during project implementation. However, these potential adverse impacts would be mitigated through the application of the design features (see Appendix C). The Proposed Action would result in long-term beneficial effects on the species because the restoration treatments would reduce the risk of high-intensity wildfire as well as improve forest health conditions within the project area.

Ground-disturbing activities may reduce some foraging success during and after the initial implementation within the project area. Foraging activities would be expected to increase within the project area after the initial implementation of disturbance. The burning associated with the Proposed Action will serve as a recruitment tool for snags within the project area and offset any loss of snags during implementation. Snag recruitment will also create opportunities for this species to perch and forage. It is expected that increased foraging and nesting activities would occur after prescribed burning. Given that important habitat features would be protected and that overall habitat conditions would improve in the long term, it is expected that the population trend for the golden eagle on the Santa Fe National Forest would remain stable under the Proposed Action.

CORRIDORS

Wildlife connectivity is important to the sustainability of numerous species. Not much is known about the wildlife movements across the project landscape and the relation to surrounding and adjacent landscapes. This project provides an opportunity to consider how the landscape may provide corridors for wildlife to move between areas of suitable habitat. Even without a full understanding of these wildlife movements, the project can be designed and implemented in a way that would provide corridor options for wildlife, should they need them.

In some cases, such as with the American marten, which migrates elevationally with the seasons, leave-islands could be strategically placed to allow passage through more open stands, considering that the marten could be vulnerable away from cover. Leave-islands could be staggered to connect with other areas that have not been treated (like steep slopes) or to connect to adjacent habitat patches (IDFs-Wild 8, 12).

In the southern part of the project area, it is known to be a corridor for mule deer. With this knowledge, project implementation can consider their potential routes as they come and go from the Forest. In doing so, treatments could be broken up along roads and boundaries so that there are not long continuous swaths of open areas that bisect their potential routes. Leave-islands could be staggered or screening could be left along roads. These types of considerations could provide the deer with more cover as they move across the landscape, protecting them from predators and hunters.

Additionally, an effort is being made across NM to improve wildlife connectivity across major roads, such as Interstate 25 along the project's southern boundary. As the project progresses, the Forest Service, NM Department of Game and Fish, and the NM Department of Transportation, have an opportunity to consider thinning treatments that might encourage wildlife, such as deer, to certain areas where road crossings may be safer for wildlife and motorists.

A project IDF (Wild-12) has been incorporated into this project to encourage improving habitat corridors for wildlife species in the area. There is no requirement to do so, nor to analyze the impacts, however, managers see this opportunity as the project is planned and implemented in areas where corridor planning could be beneficial to both wildlife and humans. Considering and implementing wildlife corridors would benefit wildlife by maintaining connections between populations, which helps to keep populations viable and allows wildlife to use a wider range of available habitats across a larger landscape.

Cumulative Effects

Cumulative effects of the Proposed Action were determined to be similar in nature for general wildlife and migratory birds (including bald and golden eagles); and therefore, are analyzed once below and applicable to the aforementioned species groups. See Table 3.1 for a list of present and reasonably foreseeable future actions considered for cumulative. Spatial and temporal boundaries for cumulative impacts analysis are the same as described above.

Ongoing and planned fuel reduction projects would continue to occur on adjacent tribal lands and other federal, state, and private lands surrounding the project area. Restoration activities would occur on adjacent public lands, including, but not limited to, the Pacheco Canyon Forest Resilience Project, La Cueva Fuel Break Project, County Line Fuel wood Treatments, Hyde Park Wildland Urban Interface Project, Santa Fe Municipal Watershed Project, Santa Fe Municipal Watershed Pecos Wilderness Prescribed Burn Project, Aztec Springs, Phase 2 & 3, Aspen Ranch (Pueblo of Tesuque), Vigil Grant (Pueblo of Tesuque), the Hyde Memorial State Park (New Mexico State Forestry) project would also increase ecosystem resilience in the analysis area. Combined, these projects would treat up to approximately 34,296 acres over the next decade. These projects along with the Proposed Action are anticipated to move ecosystems within the analysis area toward desired conditions including improved habitat. This would result in long-term beneficial impacts for various wildlife and plant species which occur within the Forest, including those discussed above by creating additional resilience across the Forest against catastrophic wildfire. However, short-term adverse impacts may occur including temporary, localized disturbance of wildlife species and their prey species during treatment activities.

Additionally, other non-forest restoration actions within the analysis area including the issuance of Forest- wide temporary and priority SUPs for non-motorized over-snow activities, Pecos Bike Trails, Santa Fe River Greenway R&PP Lease Project, may also have cumulative impacts to species when combined with the Proposed Action. These actions would contribute to an increased human and vehicle presence within known occupied and suitable habitat areas. However, related impacts are expected to be minimal and temporary in nature and mitigated through the application of design features, and therefore not expected to lead to permanent or significant impacts to any specific wildlife species, or those protected by the MBTA and Bald and Golden Eagle Protection Act.

Treatments would be designed and planned with consideration for breeding birds to minimize the potential for cumulative effects. For example, if work were to occur during the breeding season, depending on the species and vegetation types, strategic planning could allow for treatments to occur in a staggered manner, not thinning/burning entire watersheds at once, such as treating less than one-third of the NFS lands in each specific HUC 12 watershed in a given year, thus leaving at least two-thirds of the area for nesting and recruitment to continue without project disturbance, maintaining bird populations and trends.

Overall, the cumulative impacts of these actions when added to the impacts of the Proposed Action would create a synergistic effect with respect to reducing risk of severe and uncharacteristic fire upon the landscape and WUIs and in turn protect species habitat across the forest.

SUMMARY OF CUMULATIVE EFFECTS

The proposed project would have no adverse cumulative impacts because the proposed project would not adversely impact aforementioned species, and no known or reasonably foreseeable activities are proposed that would have adverse impacts on migratory birds, and bald and golden eagles

Summary

Effects on flora and fauna resources are summarized in Table 3.23.

Table 3.23. Summary of Effects on Flora and Fauna Resources

Resource	No Action Alternative	Proposed Action Alternative
General Wildlife (Sensitive)	Loss of general suitable habitat for wildlife with gradual loss of large tree groups. Risk of habitat loss from high-intensity wildfire remains elevated.	Increase in habitat diversity. Objective of vegetation mosaics (structure, age, size, distribution, arrangement, species, etc.) would provide continued and increased opportunities of numerous species. Reduced risk of habitat loss from high-intensity wildfire. Thinning would remove some habitat in the short term. Thinning would provide long-term benefit to raptors and prey species (small mammals and birds), and other species.

Resource	No Action Alternative	Proposed Action Alternative
Wildlife Migratory birds	Risk of habitat loss from high-intensity wildfire remains elevated.	Actions (thinning & burning) that open forest canopy and reduce density would improve habitat conditions for many species by increasing diversity of habitat structure, sizes, vegetation species and arrangement. Some nests and nest trees/shrubs may be unintentionally removed or burned but would be a short-term impact. IDFs would minimize negative impacts.
Large Snags	No change short term. Risk of habitat loss from high-intensity wildfire remains elevated, which could lead to an excess of snags.	Snags would not be removed during thinning. Some may burn during prescribed burning but would not be targeted. Some snags may be created by burning. Overall, no change. The Proposed Action promotes larger trees, which would eventually die over time, creating large snags.
Large Downed Logs	No change short term. Risk of habitat loss from high-intensity wildfire remains elevated.	Large Downed Logs would not be removed during thinning. Some may burn during prescribed burning but would not be targeted. Some burned snags may fall and become downed logs. Overall, no change.
Large Trees (>16 inches dbh)	Large tree loss would continue over the long term due to competition, insects, and disease. Risk of habitat loss from high-intensity wildfire remains elevated.	Large trees would not be removed during thinning. Some may burn during prescribed burning but would not be targeted. Larger pine trees would likely not be killed during burning due to fire-resistant bark. Large trees may experience less competition and improved health and resilience.
Canopy Cover over 40%	No change short term. Risk of habitat loss from high-intensity wildfire remains elevated.	Smaller/Medium-sized trees that are not removed would be allowed to expand their crowns to contribute to higher canopy cover. MSO Recovery Habitats that are currently over 40% canopy cover, would not be reduced below 40%.
Small Mammals	No change short term. Risk of habitat loss from high-intensity wildfire remains elevated. Aspen loss would continue so that species associated with aspen would decline.	Burning would limit cover for small mammals for a short period (less than a year), but subsequent growth would provide more cover. Stimulation of herbaceous understory; creates more prey forage in grasses, leaves, flowers and seeds. Improved aspen stands would contribute to diversity and abundance of prey.

3.6 Watersheds and Hydrology

Watershed resources are soil (productivity), water (water quality), and watersheds (flow regime). The focus of this section is to analyze the following questions:

Would project activities degrade soil productivity by disturbing, compacting, and sterilizing the soil?

Would project activities cause increased peak stream flows, which may flood private property and infrastructure downstream?

Would project activities degrade water quality through physical and chemical processes that add pollutants to water?

3.6.1 Affected Environment

The SFMLRP project area overlaps 10 “subwatersheds” referred to by their U.S. Geological Survey 12- digit HUCs, or interchangeably referred to within this report as “watersheds” (Table 3.24).

A subwatershed encompasses between 9,600 and 40,000 acres. More detailed maps can be found in the Watershed Specialist report (U.S. Forest Service 2021a).

The watershed condition framework (WCF), an analysis methodology developed by the Forest Service, classifies the state of all NFS watersheds and provides guidance to help the national forest evaluate, prioritize, and measure the progress of restoration within watersheds (USFS 2022a). Sub-watersheds are classified as one of three condition categories:

Class 1 (properly functioning) – Watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition, and they are functioning properly.

Class 2 (functioning at risk) – Watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition, and they are functioning, but at risk.

Class 3 (impaired function) – Watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition, and their function is impaired.

The conditions of project area watersheds were evaluated in 2016 by SFNF staff; eight were found to be functioning at risk, one is functioning properly, and one was not rated because few acres are managed by the U.S. Forest Service (see Table 3.24). Properly functioning watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. They have terrestrial, riparian, and aquatic ecosystems that capture, store, and release water, sediment, wood, and nutrients within their range of natural variability for these processes. At risk watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition while these qualities are extremely degraded within impaired watersheds (USDA 2011).

Three project area watersheds have waterbodies which are not meeting state water quality standards for their designated beneficial uses:

- Headwaters Santa Fe River- The Santa Fe River (within the municipal watershed) is listed as impaired (303d) for aluminum (thought to be naturally occurring).

San Cristobal Arroyo-Galisteo Creek- Galisteo Creek is listed (303d) for temperature, although it has a total maximum daily load (TMDL[1]) prescribed.

- Glorieta Creek- Glorieta Creek is listed (303d) for flow regime modification[2]

[1] A TMDL defines the amount of a pollutant a waterbody can assimilate without violating a state's water quality standards. It allocates that load capacity to known point sources and nonpoint sources at a given flow. It further identifies potential methods, actions, or limitations that could be implemented to achieve water quality standards.

[2] The NM Office of the State Engineer has authority over water rights which affect stream flow and the flow regime; this impairment is therefore not discussed further in this report.

Table 3.24. Project Area Watersheds, Current Conditions, and Proposed Treatments

Watershed (HUC 12)	Size (acres)	2016 Watershed Condition Function Rating	Proposed Prescribed Fire (%)	Proposed *Hand* Thinning (%)	Proposed *Mechanical* Thinning (%)
Arroyo Hondo	16,417	Properly Functioning	19	3	5
Dry Gulch-Pecos River	27,274	At Risk	4	1	1
Glorieta Creek*	21,431	At Risk	32	5	12
Glorieta Creek-Pecos River	20,267	At Risk	13	2	4
Headwaters Rio Tesuque	26,072	At Risk	25	9	6
Headwaters Santa Fe River* (municipal watershed)	34,798	At Risk	6	1	0.3
Rio Nambe	31,685	At Risk	9	3	2
Rio Tesuque-Pojoaque Creek	27,838	At Risk	6	3	3
San Cristobal Arroyo-Galisteo Creek*	38,018	At Risk	28	5	5
San Marcos Arroyo	26,434	Not Rated	2	0	0.5

3.6.2 Environmental Consequences

Methods and Assumptions Used for Analysis

The analysis area for watershed is the 10 subwatersheds that overlap with the project area. Short-term effects are defined as those which occur and disappear within 5 years. Long-term effects are those which may occur within 5 years, but which persist much longer. Cumulative effects consider the past 15 years, and 15 years into the future.

To analyze impacts to soil productivity and watershed health, vegetative groundcover was utilized as an indicator. Vegetative groundcover promotes the infiltration of precipitation and slows the flow of water on the ground. Intense wildfire affects streamflow by altering a watershed's water-balance (i.e., evapotranspiration is reduced, infiltration is reduced, soil moisture storage is reduced, groundwater recharge is reduced); by decreasing the other water pathways, overland flow and streamflow are increased (exacerbated by the formation of hydrophobic soil layers, common to high-intensity wildfires). Vegetative groundcover also protects soil from erosion because it binds the soil with its roots and slows the flow of water of the ground surface, also reducing sediment pollution. Without protective ground cover to cover and bind the soil with roots, soil and debris are easily dislodged and transported downslope to stream channels (e.g., debris flows).

Watershed flows are assessed by analyzing stream flows and flooding. Stream flow from a watershed can be viewed as a balance; inputs must equal the sum of outputs. Therefore, precipitation within a watershed (input) must equal the sum of evapotranspiration, sublimation, soil moisture storage, groundwater recharge, and stream flow (outputs). Changes to watershed properties (e.g., ground cover, canopy cover, infiltration) can affect the outputs that govern how quickly and how much water reaches the stream. In the event of a large storm and diminished output, flooding (i.e., extreme streamflow) can occur.

Water quality was analyzed by looking at impacts to erosion and sedimentation, stream temperature, and water chemistry. The U.S. Forest Service Enterprise Wetness model (USDA 2018) was utilized to analyze erosion generated by fires and the Watershed Erosion Prediction Project (WEPP) model (Elliot et al. 2000) analyzed erosion and sedimentation from the hillside as if a high-intensity wildfire burned it. The Enterprise Wetness model was used to identify the hillslopes within the project area which are most vulnerable to erosion and mass wasting (based on hillslope gradient, soil, aspect, existing vegetation, and solar radiation data; USDA 2018). This model identified a hillslope (~60% slope gradient) above McClure reservoir (a City of Santa Fe Municipal water source) as particularly sensitive to disturbance; which was then selected for further analysis by the WEPP model. From this hillslope, potential erosion can be extrapolated for adjacent hillslopes and watersheds as an over-estimate of potential adverse impacts .

The WEPP model (Elliot et al. 2000) was then used to assess potential erosion (in sediment volume) from the identified hillslopes. The WEPP model utilized four disturbance scenarios on the identified hillslope: proposed thinning, prescribed fire, prescribed fire on more gentle slopes (those typical of the project area; 40 percent gradient), and wildfire. For each scenario, three annual climates were modeled representing an average year's precipitation, a year with above average precipitation (15-year return interval), and a year with significant precipitation (30-year return interval). Table 3.25shows the modeled results of upland erosion and sedimentation into McClure Reservoir for each scenario assessed (for the first year following implementation). McClure Reservoir data were used for this analysis due to similar slopes and ERUs within the Santa Fe Municipal Watershed EIS compared to the SFMLRP area. The City of Santa Fe routinely samples the Santa Fe River, McClure, and Nichols reservoirs as part of their city water management activities in the Upper Santa Fe River watershed. The City shared their 2007, 2011, and 2017 sampling data with the author of this report (available in the project record). The data were used to better understand water quality after prescribed fire. As noted in Chapter 1, the majority of the Santa Fe Municipal Watershed is excluded from SFMLRP because the municipal watershed has other NEPA decisions associated with them.

The following aspects of the Proposed Action were not analyzed because they were not found to cause unique (different effects from those analyzed within this report) or significant issues for watershed resources:

- Riparian treatments
- Road closure

Alternative 1: No Action Alternative

Under the No Action Alternative, current management plans would continue to guide the management of the project area. No prescribed burning, vegetation or riparian restoration treatments would be implemented to accomplish project goals within the project area. Forest structure would continue to be somewhat homogenous and would continue to be dominated by a single age class. Forests would lack the desired level of diversity in structure, composition, and density and forest susceptibility to insects and disease (e.g., bark beetles and mistletoe) would continue to increase. Consequently, the risk of uncharacteristic fire intensity would also continue to increase. As forest characteristics move away from desired conditions, and the risk of high-intensity wildfire increases, watershed function and the ability to provide water to plants, animals, and humans during drought (and climate change) are threatened. Forest canopy would become denser resulting in vegetative groundcover remaining low or experiencing further declines.

SOIL PRODUCTIVITY

Under the No Action Alternative, soil productivity would experience long-term adverse impacts from further declines in vegetative groundcover. The No Action Alternative would result in declines in soil productivity as vegetation moves away from desired conditions. Vegetative groundcover is important to soil generation and protection, promoting soil productivity. The increased risk of high-intensity wildfire threatens soil productivity because intense fire behavior is more likely to occur during dryer periods, when fuel and soil moistures are very low. Dry soils transfer heat more efficiently, making soils more susceptible to physical and chemical alteration, resulting in soil that is less able to infiltrate water and increasing overland flow. Increases in runoff result in denuded soils that are more likely to become entrained, eroding and transporting to stream channels (e.g., by debris flow). As there is less soil and less productive soil on the hillslopes, vegetation has less substrate to grow in. Furthermore, the existing fuel loads are likely to promote long-duration soil heating, resulting in killing small and large roots and increased vegetation regeneration time (Busse et al. 2014). Depending on pre-existing soil properties and topography, soil productivity may be adversely affected by high-intensity wildfire for at least 12 years (Certini 2005), likely much longer. This would result in a long-term adverse impact to soil productivity.

WATERSHED FLOW

Increased stream flows and flooding would result from implementation of the No Action Alternative. Without widespread groundcover, watersheds receiving intense precipitation (e.g., monsoon rains) are less able to absorb water, which would result in increased flood events. The increased risk of high-intensity wildfire further threatens the ability of a watershed to absorb precipitation and avoid downstream flooding. Intense wildfire affects streamflow by altering a watershed’s water-balance (i.e., evapotranspiration is reduced, infiltration is reduced, soil moisture storage is reduced, groundwater recharge is reduced); by decreasing the other water pathways, overland flow and streamflow are increased (exacerbated by the formation of hydrophobic soil layers, common to high-intensity wildfires). Without ground cover and riparian vegetation, overland flow is rapidly transmitted down hillslopes and stream channels, typically resulting in larger peak flows, flooding (Neary et al. 2003), stream channel alteration, and debris flows. Bolin and Ward (1987; in Neary et al. 2003) reported a 100-fold increase in peak flow after a wildfire in a ponderosa pine and pinyon juniper forest (New Mexico).

The analysis area is especially susceptible to flood response after wildfire because of the intense convective storms which build over the Sangre de Christo mountains (U.S. Water Resources Policy Commission 1951). Adverse effects on human safety, infrastructure and aquatic ecosystems would be expected to result from high-intensity wildfire; watersheds would remain susceptible to increased peak flows until soil properties recover, and vegetation is reestablished. The recovery period to pre-disturbance peak flow levels ranges from one year to decades, depending on the intensity of disturbance, geologic, vegetative, and topographic factors (Neary et al. 2003). Therefore, implementation of the No Action Alternative would result in adverse impacts to watershed flow regime from increased stream flows and higher likelihood of flooding in the analysis area.

WATER QUALITY

Under the No Action Alternative, forest canopy cover would become denser which causes vegetative groundcover to remain low or further decline. Vegetative ground cover protects soil from erosion because it binds the soil with its roots and slows the flow of water of the ground surface (decreasing its erosive power). Without widespread groundcover, soils are more prone to erosion and waterbodies are more likely to receive sediment pollution. The increased risk of high severity wildfire further threatens water quality from super-heated soil which would result in alteration of water’s physical properties resulting in decreased infiltration and increased overland flow in addition to altering chemical processes from the use of man-made chemicals.

Under the No Action Alternative, the risk of large, uncharacteristic wildfire would increase. The WEPP model results indicate the hillslope is likely to produce 0.02 tons of sediment per acre, within the first year following a high-severity wildfire, given an average precipitation year (22 inches). (Elliot et al. 2000). For an above average precipitation year (29 inches; 15-year return period), it is estimated that 0.14 tons of sediment per acre would be produced. For a significant precipitation year (31 inches; 30-year return period), erosion and sedimentation would increase to 0.21 tons per acre; with a ton of sediment is approximately equivalent to one dump-truck load. Using the model results, if a high-severity wildfire burns the entire project area (which consists of 50,566 acres), between 1,011 and 10,619 tons of sediment could be generated the first year following the event. If the first-year sediment pulse were divided evenly between the 10 watersheds in the analysis area, as much as 1,062 tons of sediment could be delivered to each of these important streams: the Santa Fe River, the Rio Tesuque, Glorieta Creek, the Pecos River, and the Rio Nambe. This large sediment load would adversely affect water quality in these waterbodies (both suspended and bed-load sediments), affecting aquatic habitat and water treatment costs for many years, potentially decades.

Under the No Action Alternative, the increased risk of high-severity wildfire would result in the following changes to stream temperatures which adversely impacts water quality. High-intensity wildfire consumes vegetation around stream channels removing a critical source of shade which when ubiquitously removed would result in increases in stream temperatures. In addition, deposited rock, soil, and debris within stream channels increases the surface area of the water, exposing more of it to warm air and solar radiation. As stream temperature increases, other water quality parameters are adversely affected (e.g., dissolved oxygen decreases) causing biological stress (e.g., increased metabolic rates, susceptibility to infection and pollution; Lynch et al. 1984).

Galisteo Creek is listed as impaired for not meeting New Mexico state water quality temperature standards for High Quality Cold Water (303d listed; New Mexico Environment Department 2017). Under the No Action Alternative, a high-severity wildfire would be extremely detrimental, exacerbating an existing problem, making reducing stream temperatures (and therefore meeting state standards) very difficult for many years (likely decades). Similarly, water quality and aquatic habitat within other streams in the project would also face significant decline from the increased risk of high-severity wildfires.

The increased risk of high-severity wildfire would result in the following impacts to water chemistry under the No Action Alternative. High-severity wildfire releases ions, metals, and nutrients from wood and soil which are then mobilized during precipitation events and delivered to stream channels. Some of the primary constituents of concern are nitrate (NO_3^-), phosphate (PO_4^{3-}), calcium (Ca^{2+}), magnesium (Mg^{2+}), and potassium (K^+) because they are nutrients to algal growth (which can cause water to become depleted in oxygen). Other major concerns are increased dissolved organic carbon (DOC) from high-severity wildfire which reacts with chlorine during water purification treatment, forming byproducts known to cause cancer (Hohner et al. 2019). DOC also prevents water from reacting well with chemical coagulants, the primary method of water purification in the Santa Fe municipal watershed (Johansen 2020). Changes in concentrations of sulfate, pH, total dissolved solids (e.g., ash), chloride, iron, manganese, and aluminum have also been measured (Stednick 2010). Elevated concentrations of these constituents are likely to seasonally pulse in the project area with spring runoff (Spencer et al. 2003).

While prescribed fire can increase nutrient and chemical constituent levels in streams, measured concentrations are generally lower after prescribed fire than after wildfire (Stednick 2010); the difference likely related to the severity of watersheds burned, a persistent decrease in ground cover and the corresponding increase in runoff (Rhoades et al. 2011). Altered water chemistry by a high-severity wildfire has been found to last at least 14 years (Rhoades et al. 2019).

Alternative 2: Proposed Action

Under the Proposed Action, treatments are based on vegetation type (ERUs), vegetation density (aerial photo assessment), and topography (aspect, slope gradient) and for watersheds in the analysis area there would be more acres burned than thinned (burn units overlap thinning units).

SOIL PRODUCTIVITY

Under the Proposed Action, mechanical treatments involving the use of heavy equipment for thinning vegetation would result in degraded soil productivity by disturbing, compacting and sterilizing the soil. These activities would result in soil disturbances and compaction, making soils more susceptible to erosion, less able to absorb water, and less productive (Stednick 2010). The use of skidders and bobcats may adversely affect the soil by removing ground cover and furrowing, making it more susceptible to erosion by gullying. While the use of masticators results in soil compaction and runoff effects, Hatchett et al. 2006 found the effect of the masticator on runoff and erosion was ameliorated by the groundcover (mulch) generated by the machine. Therefore, implementation of design feature Soil-6 would minimize these impacts.

A Sierra Nevada study (in Ponderosa pine forest) investigated the effects of fuels treatments on ground cover and mid-story vegetation, finding that mastication and hand removal treatments aided in reducing mid-story fuels, but these treatments by themselves did not increase understory plant diversity. The additional treatment of prescribed burning not only further reduced fire hazard, but also increased exposed mineral soil, which likely promoted native plant diversity above pre-treatment levels (Kane et al. 2010).

Under the Proposed Action, mechanical treatments would occur only on slopes with gradients less than 40 percent, which significantly limits mechanical treatment acres within each watershed. For example, before prescribed fire, Glorieta Creek watershed likely needs 3,643 acres thinned (approximately 17% of the watershed area) and using the slope analysis only 2,571 of those acres (approximately 12%) of the watershed area could be treated mechanically, with the remaining treatments being conducted by hand (as shown in Table 3.24). The use of a slope constraint to limit the acres of mechanical treatment per watershed would help to minimize adverse impacts to soil (and watershed processes) at the watershed scale. Furthermore, while soil compaction can last for up to 50 years, it is repaired by a frequent freeze-thaw cycle (Greacon and Sands 1980; Webb et al. 1986) which pushes soil particles away from one another as ice expands. Freeze-thaw commonly occurs many times throughout the winter within the middle and lower elevations in the analysis area. Overall, the long-term benefits of heavy equipment use include fuels reduction, promotion of ground cover and biodiversity and these would outweigh the temporary adverse effects of soil compaction and the potential for watersheds to become less resilient to future disturbances including climate change.

Under the Proposed Action, pile and broadcast burning would result in adverse impacts to soil productivity and watershed processes from super-heating due to changes in soil fertility, organic matter content, water infiltration, soil mineralogy, and nutrient availability. Soil heating is minimized by high soil moisture (>65% by volume) and short burn duration (dependent on fuel type) (Busse et al. 2014). Under the Proposed Action, prescribed fire activities would be implemented when soil moistures are high enough (e.g., fall and spring months) to minimize the adverse impacts of soil heating.

The potential for adverse effects on soil and watershed processes by mechanical equipment and prescribed fire would be further minimized by the effective implementation of design features Water-11 (installing waterbars on fireline), Water-7 (excluding heavy equipment from riparian areas), and Rx-7 (controlling pile composition). Adverse effects on watershed resources are therefore expected to be minimal, short term, and insignificant when compared with the adverse effects of high-severity wildfire.

WATERSHED FLOW

Under the Proposed Action, project activities may cause increased peak stream flows which may flood private property and infrastructure downstream. Changes to watershed properties (e.g., ground cover, canopy cover, infiltration) would affect the streamflow that govern how quickly and how much water reaches the stream. Given a large enough storm event and diminished output, flooding (i.e., extreme streamflow) can occur.

A paired-basin study within the Upper Santa Fe River watershed (above McClure Reservoir; 8) was conducted from 2009–2017 (Lewis 2018). The study evaluated approximately 450-acre study basins to assess effects of thinning and burning on the water balance by measuring precipitation, streamflow, soil moisture, groundwater recharge, and evapotranspiration comparing these elements for a basin that had been treated with an adjacent untreated basin. The study found that the treated basin within the Upper Santa Fe River watershed did not exhibit greater streamflow than the control basin. During the study, a record-setting rainfall event resulted in total water yield from the control basin equal to about five times that from the treated basin. The storm also caused a debris flow within the control basin, but no sediment delivery from the treated basin. The study concluded the difference in water yield between basins was due to increased live ground cover (grasses and forbs) in the treated basin (resulting from a thinner canopy cover) (Lewis 2018). An increase in live ground cover would improve basin infiltration, diminish overland flow, and increase the time it takes for a drop of water to reach the watershed outlet.

Several activities under the Proposed Action would result in retaining and promoting ground cover. Overstory would be thinned, which increases light on existing areas of bare soil, and prescribed fire (low to moderate intensity) would help promote the establishment of grasses and forbs (Kane et al. 2010), with these types of understory vegetation are able to resprout within 1 year (Sackett and Haase 1998). In addition, the typical timing of prescribed fire (e.g., October) would allow seeds enough time to become established before the monsoon season (e.g., July) when overland flow is most likely. Further, the implementation of project design features Rx-7, Rx-10, Thin-1 through Thin-10, and Soil-1 through Soil- 8 would assist in slowing overland flow as well as retaining seeds and soil on hillslopes (see Appendix C). In comparison with the potential effects on soil and ground cover by high-intensity wildfire, those by the Proposed Action are expected to be insignificant making the probability of increased flooding unlikely (Neary et al. 2003).

WATER QUALITY

Under the Proposed Action, forest thinning activities have the potential to cause erosion and sedimentation in areas where soils are physically disturbed. Where trees and brush are cut by hand, human footsteps can dislodge soil particles, especially on steep slopes. Trees and brush dragged across a hillslope can furrow the soil, making it more susceptible to erosion.

The WEPP model was utilized to analyze erosion and sedimentation impacts from project activities. Table 3.25 shows the modeled results of upland erosion and sedimentation into McClure Reservoir for each scenario assessed (for the first year following implementation). As stated above, the WEPP model shows background erosion rates in the project area are about 0.000004 tons/acre of sediment annually. Hand thinning is unlikely to cause additional erosion, even if a very wet climate were to occur the year following treatment. Given a significant precipitation year, erosion and sedimentation volumes from steeper slopes are more than those from slopes with gradients common to the project area (0.14 vs. 0.12 tons/acre respectively). Implementation of project design features Water-7 through Water 11, Rx-5 through Rx-10, Thin-1 through Thin-10, and Soil-1 through Soil-8 would further minimize erosion and sedimentation impacts to soils and water quality (see Appendix C).

Table 3.25. WEPP Model Erosion and Sedimentation Results Summary

Treatment	**Upland Erosion** Average Annual Precipitation[1] (tons/acre[4])	**Upland Erosion** Above Average Annual Precipitation[2] (tons/acre[4])	**Upland Erosion** Significant Annual Precipitation[3] (tons/acre[4])
Background	0.000004	N/A	N/A
Thinning Alone	0.00*	0.00*	0.00*
Prescribed Fire – 40 percent slopes Average Project Area Conditions	0.01	0.06	0.12
Prescribed Fire – 60 percent slopes Above McClure Reservoir	0.01	0.06	0.14
High-intensity Wildfire	0.02	0.14	0.21

*In addition to background erosion
1. (~2 Year Recurrence) 22 inches
2. (15 Year Recurrence) 29 inches
3. (30 Year Recurrence) 31 inches
4. Reported figures for first year after treatment

Prescribed fire and pile burning would result in the removal or reduction of ground cover from the soil surface, making it less resistant to erosion by overland flow. Areas of prescribed fire which burn with higher intensity (vegetation consumption) are more likely to cause sedimentation because they remove all (or nearly all) the existing ground cover, consume roots up to (0.25 cm in diameter) inhibiting grass and forb regeneration, as well as decrease or eliminate future needle-cast (fire affected needles fall on the ground) over the soil. Lower intensity burns do not fully consume duff layers or plants and burned limbs generally maintain needles for immediate ground cover (USDA 2016).

The WEPP model found that prescribed fire may cause some erosion (and sedimentation) but is unlikely to cause more erosion on steeper slopes (>60 percent gradient) than typical slopes (~40 percent gradient) during an average precipitation year. When extrapolating these results to the larger project area, the Proposed Action limits broadcast burning to 4,000 acres annually across the entire project area; if these 4,000 acres were burned in a single watershed, the WEPP model indicates 40 tons of sediment (about 6 dump-truck loads) would be eroded and delivered downstream (assuming an average precipitation year and typical slope gradients of 40 percent). If the climate becomes wetter, erosion and sedimentation would increase to 480 tons. In comparison, given a high-intensity wildfire of the same size (4,000 acres), erosion and sedimentation doubles (80–840 tons, depending on the climate); in reality however, wildfires can be much larger than 4,000 acres, resulting in greatly more erosion and sedimentation within a single year. Implementation of design features (e.g., preventing ignition within riparian areas, falling trees on the contour, the cessation of grazing post-burn) protect watershed resources from impacts to water quality by protecting or promoting ground cover in addition to halting and diverting overland flow (U.S. Forest Service 2021a).

Heavy equipment, such as masticators (fuels reduction), bobcats (fire-break construction) and utility terrain vehicles (UTVs) (transportation) would result in compacted soil, which increases soil density (Greacen and Sands 1980; Hatchett et al. 2006). Water is less able to infiltrate denser soil, resulting in increased overland flow and subsequent erosion (Greacen and Sands 1980). Implementation of project design features Water-7 through Water 11, Rx-5 through Rx-10, Thin-1 through Thin-10, and Soil-1 through Soil-8 would further minimize the reduction in groundcover and use of heavy equipment resulting in compacted soil and thus reduce impacts to soils and water quality (see Appendix C).

In the long term, sediments eroded and delivered to a waterbody may gradually transport beyond the analysis area, depending on sediment volume, climate and scale of flooding as well as ground cover. Sediment eroded by low-intensity prescribed fire is not as likely (as that by high-intensity wildfire) to be transported to stream channels because of the residual ground cover (Stephens et al. 2004). Under the Proposed Action the risk of high-intensity wildfire is lessened which results in less erosion and sedimentation and more groundcover. Therefore, adverse impacts to water quality (and aquatic habitat) would be minimized from reduction in high-intensity wildfire under the Proposed Action.

Under the Proposed Action, thinning treatments would occur in riparian areas for fuel reduction and riparian vegetation restoration. Proposed thinning and burning activities, especially within riparian areas, have the potential to reduce stream shade and increase stream temperatures until riparian vegetation responds to the increased sunlight which takes approximately 5 years, resulting in short-term adverse impacts to water quality. Within the analysis area, Galisteo Creek is listed as impaired by the NM Environment Department for water quality (temperature) because it is not meeting state water quality standards for its designated beneficial use as High Quality Cold Water for aquatic life. Water temperature is most affected by solar radiation; removing stream-side canopy cover can adversely affect stream temperature by reducing shade (Brown and Krygier 1970). Implementation of project design features Thin-4 and Thin-5 would prevent significant reductions in stream shade from occurring in addition to riparian planting activities to help increase stream shade.

Because prescribed fire consumes vegetative ground cover and heats the soil, it can adversely affect water quality through erosion and sedimentation as well contribute nutrients and other water quality constituents (e.g., carbon and heavy metals) to streams. Water quality is also adversely affected when vegetation providing stream shade is consumed, resulting in increased stream temperatures. For the following reasons, adverse effects on water quality by the physical and chemical processes associated with the Proposed Action (low to moderate intensity prescribed fire; broadcast and pile burning) are not expected:

- Numerous project design criteria would protect soil from erosion; see the design features Soil-1 through Soil-8, Rx-1 through Rx-10, Thin-1 through Thin-10, and Water-1 through Water-11 (see Appendix C).
- Low to moderate soil heating by prescribed fire retains soil and root structures which makes soil more resistant to erosion and sedimentation (Busse et al. 2014; Certini 2005).
- Low to moderate soil heating by prescribed fire does not kill all vegetation or seed in the soil (Busse et al. 2014); where vegetation was present before prescribed fire, given precipitation, revegetation is expected.
- An increase in nutrient availability (released from the soil by a low- to moderate-intensity prescribed fire) would promote the rapid establishment of groundcover vegetation (Certini 2005). Once groundcover is established, it would help to diminish erosion, as well as filter and infiltrate water (Stednick 2010). Groundcover has been shown to reduce the delivery of soil and other contaminants to streams (Stednick 2010).
- Within affected pastures, grazing would be deferred for at least one year; longer if vegetative ground cover is not thriving and adequate to protect the soil from erosion (Range-12).
- The duration of potential water quality impacts by prescribed fire are largely controlled by fire intensity and ground cover regeneration (Rhoades et al. 2019; Rhoades et al. 2011; Stednick 2010); broadcast burns are planned to be low to moderate intensity and are expected to result in an overall increase in vegetative ground cover.
- Local to the proposed project area, study results (Shepard and Cadol 2018) found a 2017 broadcast burn in the Upper Santa Fe River watershed did not have any significant adverse effects on water quality by monitored constituents; increases in DOC and particulate organic

carbon, were not found to be larger than the U.S. Environmental Protection Agency (EPA) maximum contaminant levels for drinking water; the increases were very short lived (<1 year), and were less than increases previously observed after a large natural stormflow event. No increase in heavy metals or other ions were detected (Shepard and Cadol 2018). The Proposed Action is expected to have similar results because soils and topography within the 2018 study are similar to those in the proposed project area; also, burn severity and vegetative groundcover response should be similar.

- If deficient or affected, riparian vegetation would be planted to increase stream shade.
- Riparian areas would not be ignited but prescribed fire would be allowed to creep into these areas.

Under the Proposed Action, project activities involving the use of fuel and chemicals which could result in water contamination, including water sources within the City of Santa Fe's municipal watershed. Petroleum fuels would be utilized with the use of the following equipment: hand thinning with chainsaws, fire-line and piles are ignited with drip-torches, and gasoline powered UTVs provide remote transportation. Under the Proposed Action there would be the risk of contaminating surface and groundwater in the event of a fuel spill. These risks would be elevated where fuel is handled or stored in close proximity to surface water. The effects on aquatic habitat and drinking water quality would vary depending on the location and volume of fuel spilled. Impacts to surface water would be expected to last until the next significant rain event dilutes the contaminant concentration, which could take several months to years. Impacts to groundwater would be expected to last much longer (years), depending on subsurface properties. Design features Water-2 through Water-4 would be implemented to prevent spills, protecting water quality from the potential for adverse effects (see Appendix C).

Under the Proposed Action, aerial ignition devices would be utilized. These include plastic ping-pong balls filled with highly flammable potassium permanganate which would be injected with ethylene glycol (antifreeze) immediately prior to being dropped from a helicopter. Within 30 seconds, the chemical mixture within the ball reacts, generating heat and flames that ignite fine fuels where the ball lands on the forest floor. The exothermic reaction creates heat, potassium carbonate, manganese dioxide, carbon dioxide, and water. Ethylene glycol by itself is moderately toxic if ingested (large doses are fatal) by humans and animals; however, the ethylene glycol used in this process is consumed or converted into harmless compounds by chemical reaction with potassium permanganate inside the ping-pong ball; any unreacted ethylene glycol breaks down in air in approximately 10 days, and in water or soil in a few weeks. Any incidental release of unreacted ethylene glycol is not anticipated to adversely affect water quality because the overall quantity of ethylene glycol used during a broadcast burn is small, very few ping-pong balls fail to react and combust, and when ethylene glycol is combusted in reaction with potassium permanganate, the resulting compounds are harmless (U.S. Forest Service 2021a).

To date, there is no evidence that aerial ignition devices are contaminating the City's surface water supply; manganese is naturally occurring at slightly elevated levels within the watershed (Wells 1918). In addition, sodium permanganate is deliberately utilized as an oxidant at the City's water treatment plant to improve drinking water quality (Hook 2020a). As a strong oxidant, sodium permanganate can be used to improve taste, odor, and color, as well as control the formation of trihalomethanes and biological growth within the treatment plant's infrastructure. Further, manganese dioxide, one of the compounds formed by the reaction within the aerial ignition devices, is easily removed at the water treatment plant along with other solids. Therefore, even if some devices fail and do not ignite, the treatment plant is able to easily remove or neutralize the subsequent manganese compounds from the raw water (Johansen 2020).

Given manganese is naturally occurring within the municipal watershed (Wells 1918), and raw water samples in the watershed have been high in manganese since before aerial ignition devices were deployed (Puglisi 2020), the continued use of these tools are thought not to adversely affect water quality. In addition, after prescribed fires were ignited by aerial ignition, water quality samples showed manganese levels are within the range of the naturally occurring continental background levels[3]. This supports the use of aerial ignition devices in other project area watersheds, as it suggests manganese concentrations in waterbodies are not significantly increased. Further, adverse effects on aquatic species have not been observed (Hook 2020b).

Cumulative Effects

See Table 3.1 for a list of present and reasonably foreseeable future actions considered for cumulative effects for watersheds and hydrology. The spatial boundaries for analyzing the cumulative effects on watersheds and hydrology is the same subwatersheds analyzed for direct/indirect impacts above, as it represents a reasonable region in which watershed and hydrologic conditions, when assessed in combination with other cumulative actions, could be impacted if the proposed project were implemented. Cumulative effects analysis considers activities which have occurred within the past 15 years. This analysis timeframe is based on documented effects on water quality by high-intensity wildfire which have persisted for at least 14 years (Rhoades et al. 2019).

Potential adverse effects by these activities include increased erosion and sedimentation, soil and water contamination by fuel and retardants (USDA 2015b), nutrients, carbon and heavy metals, loss of soil productivity (by soil heating), as well as increased peak flows and flooding.

Ongoing activities are most likely to contribute adverse cumulative watershed effects because many are constant, involve many entities (e.g., public recreationists, permittee holders, government bodies, developers), depend on fluctuating federal budgets, or may be beyond U.S. Forest Service control.

The potential adverse effects on watershed resources by these ongoing land-uses are many. The potential adverse effects by the Pacheco and Hyde thinning and prescribed fire projects are described above, are the same as those by past activities in the watersheds, and the Proposed Action. Reasonably foreseeable actions are limited to those that overlap project area watersheds (see Table 3.1). The potential adverse effects of a new mountain bike trail system include increased erosion and sedimentation in waterbodies, especially if these new trails do not receive regular maintenance. There may however be some beneficial effects, as this network could convert old eroding Forest roads to trails, shrinking the erodible surface to a single track. Increased attention by trail users may result in decreased erosion and sedimentation, if followed by increased trail maintenance.

The potential adverse effects by the thinning and prescribed fire projects are described above, are the same as those by past activities in the watersheds, and the Proposed Action.

Summary

Without treatment to fuels and forest structure in project area watersheds, the persistent and elevated risk of large, high intensity wildfire would continue to threaten water quality, soil productivity, and flooding into the future (Rhoades et al., 2019; Neary et al., 2003). Given the future climate in the project area is predicted to be hotter and drier (Cayan et al., 2013), watersheds need to be able to absorb as much water as possible, so they may sustain flow during dry times. Without treatment, project area watersheds would not be able to fully perform this ecosystem service; and should a high intensity wildfire occur, would be severely impaired for many years

[3] Surface waters in the United States contain a median manganese level of 0.016 mg/L, with 99th percentile concentrations of 0.4–0.8 mg/L. Groundwater in the United States contains median manganese levels of 0.005 to 0.15 mg/L, with the 99th percentile at 2.9 or 5.6 mg/L in rural or urban areas, respectively (U.S. Department of Health and Human Services 2012).

Implementation of the Proposed Action has the potential to result in short-term adverse impacts to watershed resources (soil, water quality, and flow regimes). Adverse impacts to watershed resources are expected to be minimal, short term, and insignificant when compared with those by high-severity wildfire. An overall long-term beneficial effect on watershed condition is expected. Proposed activities within the "properly functioning" Arroyo Hondo watershed (thinning, burning, riparian treatments, and road closure) would help to protect the components of the watershed that have integrity (e.g., water quality, aquatic habitat). Proposed activities within the other "at risk" watersheds would help to protect components that are functional while improving the condition of those that are degraded (e.g., vegetative ground cover, riparian vegetation). By implementing the Proposed Action, project area watersheds would become more resilient to climate change, a desired condition (as defined by USDA, 2011; U.S. Forest Service 2022b). This is because:

- Numerous project design criteria would protect soil from erosion; see the design features Soil-1 through Soil-8, Rx-1 through Rx-10, Thin-1 through Thin-10, and Water-1 through Water-11 (see Appendix C).
- While soil compaction can last for up to 50 years, it is repaired by a frequent freeze-thaw cycle (Greacen and Sands 1980; Webb et al. 1986). Freeze-thaw commonly occurs many times throughout the winter within the middle and lower elevations of the project area.
- Slope limitations to heavy equipment operations prohibit operations on gradients steeper than 40 percent; this means much of the project area would be treated by hand, diminishing wide-spread impacts to soil productivity.
- Design features would protect riparian vegetation and therefore stream shade; affected areas would be planted with riparian species.
- Prescribed fire by the Proposed Action is intended to be of low intensity. Soil burn severity would be diminished by implementing prescribed fire when soil moistures are high (e.g., fall and spring months; Busse et al. 2014).
- Soil erosion and sedimentation volumes would be diminished by low-intensity prescribed fire as compared with high-intensity wildfire (WEPP model results; Robichaud 2000).
- Heavy metals, ions and organic carbon concentrations were monitored after a 2017 broadcast burn in the municipal watershed. The water quality response (for all constituents studied) was not largely adverse, was very short lived (<1 year), and was less than that by a large natural stormflow event. Further, all post-burn increases were less than the EPA's maximum contaminant levels for drinking water quality (Shepard and Cadol 2018).
- The potential water quality effects on stream nutrients are significantly less in terms of concentration (Stednick 2010; Meixner and Wohlgemuth 2004) and duration (Rhoades et al. 2019; Stephens et al. 2004) by prescribed fire than by high-intensity wildfire.
- The establishment of ground cover is a significant control on the recovery of water quality (Rhoades et al. 2011) to pre-treatment conditions.
- Most broadcast burns (low to moderate intensity) promote the rapid establishment of vegetative ground cover (Certini 2005) because they:
    - Preserve soil structure while also increase available plant nutrients.
    - Increase light on existing areas of bare soil once overstory vegetation is thinned.
    - Promote the establishment of grasses and forbs (Rhoades et al. 2011; Kane et al. 2010) which are typically able to resprout within 1 year (Sackett and Haase 1998).

  - Allow seeds enough time to become established before the monsoon season (e.g., July), when overland flow is most likely; broadcast fire is typically implemented during the spring and fall.
  - Protect the soil with residual duff and needles immediately after the burn and later with needles cast off the dead branches in the overstory (USDA 2016).
- Design criteria would prohibit grazing any pasture for at least one year following a broadcast burn, potentially longer depending on ground cover response and vitality.
- Aerial ignition devices have not been shown to adversely affect surface water quality (Puglisi 2020) and some manganese is naturally occurring within the municipal watershed (Wells 1918). After prescribed fires were ignited by aerial ignition, water quality samples showed manganese levels to be within the range of the naturally occurring continental background levels. Further, manganese is removed during treatment from the potable water supply (Johansen 2020). Finally, adverse effects on aquatic species have not been observed (Hook 2020b).
- To protect water quality from fuel spills, best management practices and design criteria would be implemented.

3.7 Riparian Resources

The focus of this section is to analyze the following questions:

How would the proposed treatments affect conifer overabundance in riparian areas?

How would the proposed treatments affect the current overabundance of late seral conditions in riparian areas?

How would the proposed prescribed fire treatments affect riparian vegetation?

3.7.1 Affected Environment

Overview

The SFMLRP project area includes several riparian ERUs (Triepke et al. 2018, U.S. Forest Service 2015a) but is composed primarily of the narrowleaf cottonwood/shrub type (Figure 3.16) and ephemeral riparian (Figure 3.17). Together the ephemeral types and the narrowleaf cottonwood/shrub are the focus of this analysis, particularly where narrowleaf cottonwood/shrub occurs in the Tesuque Creek watershed (Table 3.26).

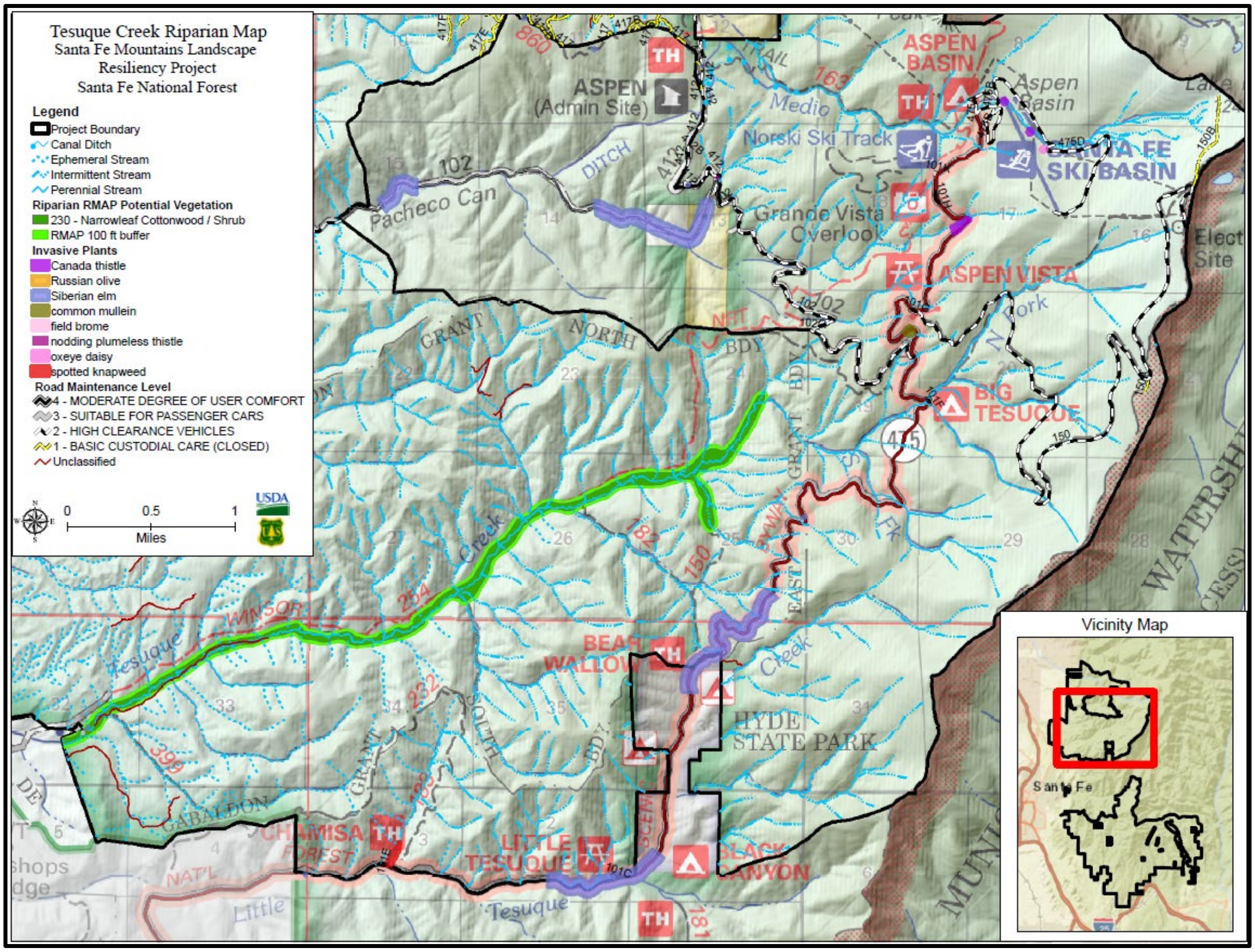


Figure 3.16. **Proposed riparian restoration area along Tesuque Creek composed mostly of narrowleaf cottonwood/shrub ERU.**

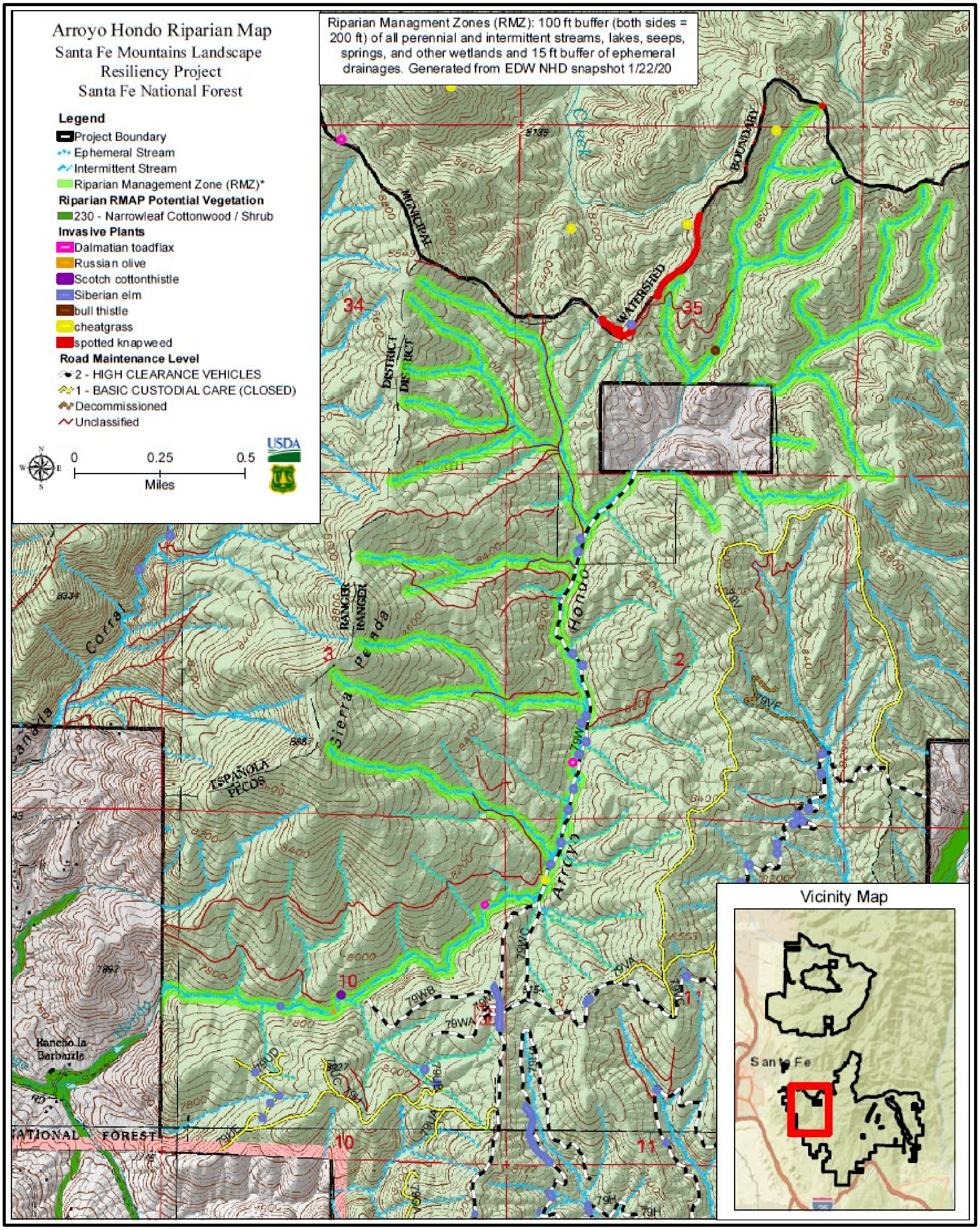


Figure 3.17. Proposed riparian restoration area along Arroyo Hondo composed mostly of ephemeral (unmapped) ERUs.

Table 3.26. Analysis Area for Riparian Resources

Watershed Drainages	ERU	Proposed Treatment Area (acres)
Tesuque Creek Main Drainage	Narrowleaf Cottonwood/Shrub	310
Arroyo Hondo Main Drainage	Ephemeral riparian	370
Total		**680**

Riparian areas of the project area generally occur within drainage bottoms surrounded by steep hillslopes. They are generally narrow, steep, and confined by bedrock. At lower elevations, the drainages widen and slope gradients decrease, allowing for broader floodplains and increased riparian vegetation. Depending on micro-site habitat and disturbance processes, evergreen species (e.g., blue spruce, ponderosa pine, Douglas-fir, Rocky Mountain juniper) are naturally present within the riparian area, although these species have increased in abundance in the last century at the expense of native obligate riparian species such as narrowleaf cottonwood (*Populus angustifolia*). The understory may contain willows (*Salix* sp.), herbaceous species, and even upland shrubs.

The narrowleaf cottonwood/shrub ERU is concentrated between 1,900 and 10,000 feet in elevation and encompasses approximately 503 acres (0.01%) of the project area. Typical species composition in this ERU includes narrowleaf cottonwood, Thinleaf alder (*Alnus incana* ssp. *tenuifolia*), Rocky Mountain maple (*Acer glabrum*), various willows and shrub species, and the conifers mentioned above. Characteristic abundance of tree species for conifers ranges from 1% to 30% canopy cover while deciduous tree range from 10% to 25% depending on the site conditions (U.S. Forest Service 1993).

Conifer abundance in riparian areas within SFMLRP substantially exceeds the characteristic canopy cover of the ecological reference model identified in the Santa Fe Terrestrial Ecological Unit Inventory (U.S. Forest Service 1993). Increased conifer abundance has altered riparian habitat conditions and increased the risk of high-severity fire. With fire exclusion and denser vegetation in the surrounding uplands, there is a risk of wildfire burning in riparian areas with greater frequency and severity than the historic fire regime, limiting the recovery potential of these areas and favoring the encroachment of non- native invasive vegetation. Additionally, there is currently an overabundance of late seral conditions compared with desired conditions as a result of land use history, increasing conifer abundance, and drier conditions. Ecological integrity and habitat conditions depend on a balance of all seral state conditions (U.S. Forest Service 2021g).

Natural disturbances like wildfire and floods maintain riparian ecosystems by contributing sediment, nutrients, and downed wood, dispersing seeds, building floodplains, and scouring fresh surfaces for new plant growth (Fierke and Kauffman 2005; King and Louw 1998; Miller et al. 1995; Standford et al. 2005). Changes in these cycles of natural disturbance in combination with land use can impact ecosystems and favor departure from desired conditions.

Flooding is a natural physical disturbance related to climate. Minor floods of 5- to 10-year frequency barely inundates the floodplain and results in some scour and burial of herbaceous cover and seedlings (LANDFIRE 2006, 2010; Lolley et al. 2006). Moderate floods of 15- to 30-year frequency significantly inundate the floodplain and remove vegetation, mainly shrubs and small trees. Severe flooding that occur at intervals of over 50 years results in major scour and deposition on the floodplain, removing mature trees (stand-replacing events). Flood frequency of the project area appears to have decreased over the last century or so (USGS 2019). Analysis and field observation suggest that minor and moderate floods have significantly declined within all ERUs while severe floods are slightly less frequent. These conditions may be a result of a continuing drying trend expected with warmer climate (Gutzler 2013; Triepke et al. 2020). Land use (acequias and stream diversions for agriculture) may also limit flooding in some streams within the project area. Drier conditions and decreased flood disturbance have likely promoted increased establishment of conifers on floodplains, particularly for lower elevation riparian areas typically dominated by deciduous trees (Dwire et al. 2016).

Fire is also affected by climate and affected by landform, where fire behavior in riparian ecosystems that occur within narrow steep canyons can bear more on local terrain than on soil moisture and the character of riparian vegetation (Webb et al. 2019). This condition is especially representative of higher elevation streams within the project area. Lower elevation settings in broader valley bottoms likely have fire regimes that differ from those of surrounding hillslopes, with riparian areas having infrequent and patchy high severity fires, consistent with the desired conditions and as with current conditions of the project area. Records for the project area show a current average fire return interval of about 400 years (based on a 50-year Forest record) (Eidenshink et al. 2007; U.S. Forest Service 2016), with stand-replacing fires occurring infrequently as expected, but with low-moderate severity fires occurring less frequently than they were thought to have historically. The shift in seral state distribution to more late seral conditions may be related to these shifts in fire and flood regime.

Overall seral state diversity is moderately departed from desired conditions with an excess (46%–97%) of late seral plant communities and lack of riparian obligate regeneration. The amount of early seral vegetation and regeneration of deciduous woody species is similar to desired conditions; however, recent field reconnaissance suggests that much of this early seral component is decadent and being overtopped by encroaching conifer trees. The abundance of conifers in riparian corridors is uncharacteristically high at the expense of deciduous trees and shrub-herb vegetation. Exotic woody species are undesired within all riparian ERUs and currently included localized populations of Russian olive (*Elaeagnus angustifolia*), Siberian elm (*Ulmus pumila*), and other invasives. Analysis shows that the overall canopy cover of exotic woody vegetation is less than 1% and within desired conditions to the benefit of native plant communities. Spatial connectivity of riparian corridor habitat is largely intact, which is important for dispersal, access to new habitats, perpetuation of genetic diversity as well as nesting and foraging for special status species. Coarse woody debris is somewhat less than the desired conditions, but still within characteristic levels for these ecosystems to provide roles for habitat for riparian and aquatic species.

Only those indicators likely to be affected by the Proposed Action or related to the issues addressed, namely seral state diversity and functional group diversity (conifer abundance), are considered with the following environmental consequences. Fire regime is also considered: while the current riparian fire regime is within desired conditions, encroaching conifer trees and fuel conditions in the surrounding uplands may put the riparian areas at risk to loss of ecological integrity and delivery of ecosystem services.

3.7.2 Environmental Consequences

Methods and Assumptions Used for Analysis

Baseline analysis of several riparian indicators (see Table 3.30 below) was conducted to evaluate current condition and trends in ecological integrity, to inform the Affected Environment, and to help identify potential impacts to riparian communities. Some analysis results were corroborated through field surveys of the project area. The scope of the baseline analysis was generally the SFMLRP project area, except where the size of the project area was inappropriate for the analysis of certain indicators (e.g., analysis of riparian corridor connectivity) in which case the analysis area varied between watershed and sub-watershed areas adjacent to the SFMLRP project area (U.S. Forest Service 2021g). The area analyzed for Environmental Consequences is narrower, focusing on areas where proposed management activities would occur (see Table 3.24 and Table 3.26; U.S. Forest Service 2021g).

Alternative 1: No Action Alternative

Under the No Action Alternative, there would be no riparian vegetation treatments or other forest treatments.

Likely effects of the No Action Alternative on riparian vegetation include a continued increase in conifer encroachment, reflected in further departure from desired conditions for seral state diversity and functional group diversity indicators (see Table 3.27). In lieu of other disturbance agents such as flooding, conifers would continue to regenerate and infill available canopy gaps at the expense of other functional plant groups including deciduous trees and shrubs. Overall departure in seral state diversity is likely to increase as well in the coming decades as conifers mature and become denser to favor an overabundance of late seral conditions. These processes of late succession, conifer encroachment, and homogenization of ecosystem structure and composition would likely be concentrated where evergreen trees already exist and would be facilitated by the drier climate conditions of recent and foreseeable decades on the Santa Fe NF (Triepke et al. 2019). Increased abundance of evergreen trees in riparian areas and the surrounding upland forest would increase the risk of high severity fire in the riparian which, in turn, would predispose these areas to invasive vegetation and woody exotic species.

Alternative 2: Proposed Action

Impacts from the Proposed Action on riparian vegetation include decreased abundance of evergreen trees and positive trends for the seral state and functional group diversity indicators (see Table 3.27). The Proposed Action includes riparian restoration activities of thinning and removal of conifer trees from riparian areas on up to approximately 680 acres, to allow riparian vegetation to thrive and expand. The Proposed Action would help reverse or slow trends in the departure of seral state diversity from desired conditions, favoring increased woody regeneration and more early- and mid-seral deciduous vegetation. Native species such as willow, cottonwood, alder, grasses and forbs would be planted or coppiced (cut to promote regrowth) if natural regeneration is determined to be insufficient following conifer and non-native species removal. Fencing may be installed if needed to protect restored areas if it is determined that riparian vegetation regeneration is being hampered by ungulate browsing and grazing in project areas of Tesuque Creek and Arroyo Hondo. The ecological processes associated with new plant succession, added growth of deciduous trees and shrubs, and diversifying structure conditions would be concentrated where evergreen trees are targeted for thinning coincident with measures to plant or stimulate growth of deciduous plant functional groups. Overall effects of the Proposed Action would be to favor desired conditions for improved seral and functional group diversity.

Table 3.27. Summary of Current Conditions and Trends for Each Resource Condition Compared with Desired Conditions

Indicator	Departure from Desired Conditions[1]	Current Trend from Desired Conditions	Outlook for Likely Effects of Proposed Action
Seral state diversity (area percentage of each seral state on the landscape)	Moderate to high, due to conifer encroachment and uncharacteristically high levels of late seral conditions.	Away	Beneficial effect. Project could reduce conifer encroachment and proportion of late seral conditions.
Riparian woody regeneration (area percentage on the landscape)	Moderate, current levels of regeneration are somewhat elevated.	Away	No effect. Project would not affect the level of riparian woody regeneration appreciably. Efforts to regenerate woody vegetation as replacement for conifers would be minor/localized.
Coarse woody debris (pieces per mile)	Low, current levels of coarse woody debris are similar to desired conditions.	Stable	Beneficial effect. Project could increase the level of coarse woody debris closer to desired conditions.

Indicator	Departure from Desired Conditions[1]	Current Trend from Desired Conditions	Outlook for Likely Effects of Proposed Action
Exotic woody species cover (percentage of area on the landscape)	Low, current levels of woody invasive vegetation is low and localized.	Away	No effect. Project is not likely to decrease the current amount of exotic woody species.
Functional group diversity (percentage of each functional group on the landscape)	Overall departure is low, but the abundance of the 'evergreen tree' group is substantially elevated.	Away	Beneficial effect. Project could reduce the levels of evergreen trees (conifers), increasing the abundance of deciduous trees.
Flood regime (flood magnitude and frequency)	High, due to reduced flood frequency.	Stable	No effect. Flood regime will not be affected.
Fire regime (fire frequency and severity)	Low, current fire regime is similar to desired conditions; however, encroaching conifers, increasing conifer density and fuel ladder conditions pose a risk to increased fire frequency and severity in riparian areas.	Stable	Beneficial effect. Project would address fuel conditions in the surrounding uplands to reduce the risk of high severity fire and departure from desired conditions.
Connectivity (percentage of disruption of riparian corridors)	Low, current levels of riparian corridor fragmentation is low.	Stable	No effect. Project is not likely to affect current levels of riparian corridor connectivity.

1. Departure from desired conditions is measured and categorized as low (<33% departure), moderate (33%–66% departure), or high (>66% departure).

With the decrease in conifer abundance in both riparian areas and surrounding forest, there would be decreased risk of catastrophic fire because of treatments aimed at reducing the continuity of evergreen trees and favoring the maintenance of desired conditions for infrequent and patchy fires in the riparian. Low-intensity prescribed fire would be targeted in riparian areas to promote the growth of riparian obligate vegetation. Some backing fire could creep into riparian areas and kill or top-kill obligate vegetation; however, these effects are expected to be localized and may occasionally be beneficial as fire can stimulate the regeneration of woody species. Per design feature Rx-10, firelines would not be installed parallel to stream channels or drainage bottoms. Firelines that must intersect stream bottoms would be installed perpendicular to the stream in a manner that minimizes the stream and riparian area affected and that would prevent the fireline from becoming a channel (see Appendix C). To limit erosion and retain the long-term productivity of riparian areas, burning would be implemented when the duff layer (decomposed organic matter in contact with the soil surface) is moist enough so ensure a cool burn (design feature Soil-8; see Appendix C). Collectively, design features and reduced fire risk by the proposed alternative would help to ensure desired conditions for fire regime are maintained.

Any non-native woody vegetation encountered such as Siberian elm, Russian olive, and salt cedar (*Tamarix* L.) would be cut and removed. Design features of this project include measures to limit the spread of invasive vegetation, including the exclusion of equipment staging, fueling, and repair or maintenance activities from riparian and buffer areas—i.e., riparian management zones (design feature Water-4 and Plant-3; see Appendix C). Vehicles and heavy equipment would be operated within riparian management zones only when absolutely necessary, and then only on designated routes and crossings (Water-7; see Appendix C). An incidental benefit of conifer removal would increase the abundance of coarse woody debris habitat, as larger tree boles that are cut would be left in and near the active floodplain. Road closure planned with this alternative could help maintain desired conditions for riparian corridor connectivity and may reduce the likelihood of vehicle traffic spreading invasive and exotic vegetation to riparian areas.

Cumulative Effects

See Table 3.1 for a list of present and reasonably foreseeable future actions considered for cumulative effects on riparian resources. The spatial boundary for analyzing the cumulative effects on riparian areas is the Santa Fe National Forest, as it represents a reasonable region in which riparian resources, when assessed in combination with other cumulative actions, would be impacted if the proposed project were implemented. The temporal boundary for analyzing the cumulative effects is 25 years, which is the estimated duration of the SFMLRP.

Recent past, ongoing, and planned fuel reduction projects would continue to occur on adjacent tribal lands and other federal, state, and private lands surrounding the project area. These would have cumulative short-term adverse and long-term beneficial impacts on riparian resources. Short-term increases in soil erosion could also impact water quality depending on the proximity of the project to stream courses. These impacts are expected to be mitigated on a project-by-project basis through the application of resource protection measures so it is not anticipated that cumulative negative impacts would result from the implementation of the Proposed Action coupled with other restoration activities Restoration activities would occur on adjacent public lands, including, but not limited to, the Aztec Springs (Phases 2 and 3), Aspen Ranch, Vigil Grant, Hyde Memorial State Park, and Santa Fe Municipal Watershed projects, would also increase ecosystem resilience in the analysis area. Combined, these projects would treat up to approximately 34,000 acres over the next decade.

The most apparent cumulative effects on riparian vegetation include the overall reduction in the risk of catastrophic fire by the Proposed Action, in combination with activities anticipated in neighboring fire-adapted forests, including fuels treatments and forest restoration that are likely to occur in the current and future planning cycles. These management trends are likely to continue as long as needed resources are available.

Summary

Table 3.27, above, presents the summary of likely effects for each of the riparian indicators. The proposed treatments would address conifer encroachment and excessive vegetation density in riparian areas within the SFMLRP, reducing the risk of high severity fire and subsequent vulnerability to encroachment of non-native vegetation within riparian habitat. Additionally, the proposed treatments would reduce the overabundance of late seral conditions, restoring ecological integrity of riparian habitat with the SFMLRP.

3.8 Air Quality and Climate

The focus of this section is to analyze the following questions:

- How would the proposed treatments contribute to global climate change?
- How would the proposed prescribed burning treatments impact local air quality?

3.8.1 Affected Environment

Air Quality

Currently, air quality and the values dependent on air quality in the Santa Fe National Forest are generally in good condition or improving; this is because most pollutants are decreasing as a result of stricter regulations. However, modeled critical loads from nitrogen deposition are being exceeded, primarily for lichens. Conditions are expected to continue to improve due to projected emissions. Of greater concern are impacts to visibility and ambient air quality conditions associated with particulate matter (PM), which are expected to increase as a result of larger, more severe wildfires and increases in fugitive dust as the effects of climate change are realized (U.S. Forest Service 2019).

Fine particle pollution is the principal pollutant of concern in wildland fire smoke for the relatively short-term exposures typically experienced by the public. The individual PM found in wildland fire smoke is very small; collectively, they are visible to the naked eye as smoke. Approximately 90% of these particles are PM_{10} (10 microns in diameter or smaller). Of this PM_{10}, approximately 70% is $PM_{2.5}$ (2.5 microns in diameter or smaller).

Besides PM, components of smoke with implications for human health include carbon monoxide (CO), a colorless, odorless gas produced by incomplete combustion of wood or other organic materials. At high levels, CO can cause dizziness, nausea, and impaired mental function. Levels of CO are highest during the smoldering stages of a fire, especially in close proximity to the fire, and mostly affect fire personnel. Carbon monoxide breaks down quickly and generally does not impact the public.

Smoke also contains a number of toxic air pollutants such as aldehydes (including formaldehyde and acrolein) and organic compounds such as polycyclic aromatic hydrocarbons and benzene. Acrolein and formaldehyde are potent eye and respiratory irritants. Benzene is a known carcinogen that can cause headaches, dizziness, and breathing difficulties. These compounds also mostly effect fire personnel who work in close proximity to fires.

Ground-level ozone (O_3) is a secondary pollutant in that it is not emitted directly from wildland fires but can form downwind when volatile organic compounds (VOCs) and nitrogen oxides (NOx) react in the presence of sunlight. Wildland fire smoke is an important source of VOCs and NOx. While there are instances in which O_3 levels can be affected by wildland fire emissions, typically the NOx involved in O_3 formation originates from urban and industrial sources, such as vehicles and power plants (NWCG 2018).

Table 3.28 shows the amount of annual criteria pollutant (CP) particulates (PM_{10}) and nitrogen dioxide (NO_2) emissions from various sources at the local (SFMLRP counties), state, and national levels.

Table 3.28. 2014 National Emissions Inventory of Annual Criteria Pollutant Data at the Local, State, and National Levels

Source	$PM_{2.5}$ (tons)	PM_{10} (tons)	NO_2 (tons)
San Miguel County – All Sources	1,647	11,595	1,833
Santa Fe County – All Sources	3,763	31,108	5,752
New Mexico – All Sources	65,784	443,856	186,869
National – All Sources	5,405,521	18,209,509	13,463,097
San Miguel County – Prescribed Fires	287	338	41
San Miguel County – Wildfires	21	25	3
San Miguel County – Agricultural Field Burning	3	4	1
Santa Fe County – Prescribed Fires	3	4	0.4
Santa Fe County – Wildfires	0.1	0.1	0.03
Santa Fe County – Agricultural Field Burning	U/A	U/A	U/A
New Mexico – Prescribed Fires	3,329	3,929	541
New Mexico – Wildfires	5,676	6,698	906
New Mexico – Agricultural Field Burning	151	206	29
National – Prescribed Fires	780,812	919,895	152,426
National – Wildfires	886,245	1,045,755	119,147
National – Agricultural Field Burning	64,628	87,356	20,358

AIR QUALITY HEALTH STANDARDS

Recent air quality in the forest area has been good and the area complies with the National Ambient Air Quality Standards. Figure 10 in the Fuels and Wildfire Behavior – Air Quality – Climate Change and Carbon Sequestration Specialist Report (U.S. Forest Service 2021e) shows the locations of EPA-certified air quality monitoring stations in northern New Mexico. Particulate and O_3 monitoring data from northern New Mexico Counties (2005–2019) are shown in Table 9 in the specialist report (EPA 2020a, U.S. Forest Service 2021e).

Visibility

Currently, New Mexico does not have visibility goals. The state is required to develop and submit to the EPA its regional haze plan by July 31, 2021.

The Clean Air Act gives special air quality and visibility protection to certain national parks and national wilderness areas. These locations are designated as Class I areas. Class I areas are federally or tribally managed to improve visibility levels and prevent any further impairment of visibility due to human-induced air pollution (National Park Service 2020; NWCG 2016). Class I areas in northern New Mexico are Bandelier Wilderness, San Pedro Parks Wilderness, Pecos Wilderness, and Wheeler Peak Wilderness. The U.S. Forest Service cooperates with the state in monitoring air quality conditions through the Interagency Monitoring of Protected Visual Environments (IMPROVE) program. The nearest IMPROVE monitoring sites are located at Española (35-039-9000), Los Alamos (35-028-1002), and Taos (35-055-9000). From 2000 to 2017, each site has shown similar improvement in the visibility conditions, as represented by the 20% most impaired days and 20% clearest days each year. This is likely due to reductions in sulfate and may be a result of emissions control technology improvements at coal-fired electric generating stations in the Four Corners (Figures 11–16 in Fuels and Wildfire Behavior – Air

Quality – Climate Change and Carbon Sequestration Specialist Report) (U.S. Forest Service 2021e; New Mexico Environment Department 2020).

Climate Change and Carbon Sequestration

GREENHOUSE GASES

New Mexico emitted over 18,000,000 tons of CO_2 and over 6,000 tons of methane (CH_4) in 2014 (Table 3.29) (EPA 2020b).

Table 3.29. 2014 National Emissions Inventory of Annual Greenhouse Gas Emissions at the Local, State, and National Levels

Source	CO_2 (tons)	CH_4 (tons)
San Miguel County – All Sources	341,033	219
Santa Fe County – All Sources	1,349,777	102
New Mexico – All Sources	18,632,809	6,658
National – All Sources	2,257,756,571	1,108,327
San Miguel County – Prescribed Fires	37,155	164
San Miguel County – Wildfires	2,614	12
San Miguel County – Agricultural Field Burning	U/A	U/A
Santa Fe County – Prescribed Fires	385	2
Santa Fe County – Wildfires	20	0.07
Santa Fe County – Agricultural Field Burning	U/A	U/A
New Mexico – Prescribed Fires	463,827	1,887
New Mexico – Wildfires	781,826	3,221
New Mexico – Agricultural Field Burning	U/A	U/A
National – Prescribed Fires	108,914,013	423,651
National – Wildfires	110,380,596	508,106
National – Agricultural Field Burning	U/A	U/A

Note: Emissions data for agricultural field burning is unavailable (U/A) and therefore not accounted for in the analysis.

Climates change at a variety of scales. Long-term, persistent trends in temperature and humidity determine the extent and location of various life zones, as well as the elevation at which one biotic community replaces another. Short-term fluctuations, on the order of years to decades, determine drought cycles, fire frequencies, and pulses of tree reproduction. The Southwest Region is strongly influenced by oscillation in the Pacific Ocean-atmosphere system. El Niño years bring increased annual precipitation, but less rain in the summer, and La Niña years bring the opposite (U.S. Forest Service 2019).

Climate change is anticipated to have lasting, large-scale impacts to a variety of ecological, social, and economic resources around the Santa Fe National Forest. Mean annual temperatures in the planning area have increased over the last several decades, mostly with increased nighttime temperatures. There has been a decrease in the amount of snow at low to mid-elevations, and an increase in year-to-year precipitation variability (wetter wet years and drier dry years). At higher elevations, overall snowfall and spring snow-water equivalent (amount of water in snowpack) have remained steady in most southern areas, but snowmelt now occurs earlier in the year. Changes in temperature and in amounts and timing of precipitation have led to earlier peak stream flow rates in most streams, with higher spring flows and lower summer flows. These changes will have a major influence on fire across the western United States, especially in mid-elevation forests (U.S. Forest Service 2019).

While the most important determinant of fire severity is fuel condition, two other important factors determine fire regimes: vegetation type (or ERU) and weather or climate patterns. Fire history and dendrochronological studies provide ample evidence of past relationships between fire and climate. That evidence makes it clear that a changing climate will profoundly affect the frequency and severity of fires and change vegetation structure and composition as a response to more severe or prolonged droughts (U.S. Forest Service 2021e). At the forest level, the effects of climate change on vegetation are magnified where vegetation structure and composition are outside the natural range of variation, especially in high-elevation forests that are moderately vulnerable (e.g., mixed conifer with aspen, mixed conifer–frequent fire, and ponderosa pine forest) to highly vulnerable to climate change on a landscape scale. The ERUs with the highest vulnerability to climate change at the plan unit scale include alpine and tundra, pinyon-juniper grassland, and pinyon-juniper sagebrush (U.S. Forest Service 2021e). A large proportion of ERUs are well outside of the natural range of variation and are highly departed from desired conditions. Uncharacteristically dense vegetation has a lower resilience to climate change, fire, insects, and pathogens. Moreover, plant compositions that have shifted toward dominance of less drought- and fire-tolerant species have decreased resilience to climate change. The best way that land managers can align forest conditions to adapt with a changing climate is by reintroducing fire into fire-adapted ecosystems. Implementing managed fire and other management techniques in highly departed areas now is paramount to shape sustainable and resilient ecosystems for the future in the face of a changing climate (U.S. Forest Service 2019).

Outside of the impacts that changes in climate could have on vegetation, changes in ERUs would also affect wildlife, recreation opportunities, and socioeconomics. For instance, five at-risk species in the forest rely on Colorado Plateau–Great Basin grassland or on pinyon-juniper sagebrush and pinyon-juniper grassland, all of which are at very high vulnerability to climate change at various scales. Recreation opportunities could suffer from the loss of spruce-fir forest areas (such as the forested areas surrounding the Santa Fe Ski Basin), as increased tree mortality would make hiking or riding on popular trails exceedingly dangerous. In wilderness areas, trail maintenance would become increasingly difficult with additional tree mortality. Socio-economic impacts of climate change-affected vegetation in the forest may include reduced availability of forest products needed for heat (fuelwood) or sustenance (pinyon nuts), medicinal uses, and cultural traditions or practices. Scenery may also be negatively impacted, resulting in fewer (non-local) visitors to the Santa Fe, bringing less revenue into the area and reducing the need for some existing seasonal or permanent positions (U.S. Forest Service 2019).

The gathering of climate data in the Santa Fe Mountains region started in the late 1800s at weather stations that are mostly located in valleys surrounding the mountains. Average annual temperature and precipitation data from four long-term stations, ranging in elevation from 5,590 to 6,965 feet above sea level, are summarized in Table 3.30. The data from these and many other long-term stations are used in modeling climate change (U.S. Forest Service 2019; Western Regional Climate Center 2020).

Table 3.30. Average Annual Data from Long-term Weather Stations in the Santa Fe Mountains Vicinity

Weather Station	Period of Record	Elevation (feet)	Average Max. Temperature (degrees F)	Average Min. Temperature (degrees F)	Average Total Precipitation (inches)	Average Total Snowfall (inches)
ESPANOLA, NEW MEXICO (293031)	04/01/1895 to 10/07/2012	5,590	68.6	34.6	9.88	11.7
PECOS NM, NEW MEXICO (296676)	01/01/1916 to 01/31/2016	6,876	65.8	32.9	16.15	27.2
SANTA FE CO MUNI AP, NEW MEXICO (298078)	05/27/1941 to 06/09/2016	6,348	64.9	36.9	9.54	27.7
TAOS, NEW MEXICO (298668)	12/01/1892 to 04/30/2016	6,965	63.6	31.0	12.35	29.5

The emission of greenhouse gases (GHGs) by human activities and natural processes contributes to the warming of the Earth's climate. Warming could have significant ecological, economic, and social impacts at regional and global scales (IPCC 2021). The U.S. Climate Resilience Toolkit shows historic and projected Santa Fe and San Miguel Counties' temperatures and precipitation from 1950 through 2100. The climate projections are based on lower and higher GHG emissions scenarios and show significant increases in maximum and minimum temperatures and slight decreases in precipitation (U.S. Forest Service 2021e:Figures 17–22) (U.S. Climate Resilience Toolkit 2020).

CLIMATE CHANGE VULNERABILITY ASSESSMENT

The Climate Change Vulnerability Assessment (CCVA) was developed as an ecosystem-based evaluation of the potential vulnerability of Southwest ecosystems to the projected climate of the late 21st century. The CCVA results infer vulnerability based on the projected climate departure from the historic climate envelope for a given ERU and location on the Santa Fe National Forest. Two key components of the CCVA are the ability of ecosystems to resist climate change effects and maintain resilient ecosystem functions:

- **Resistance**: The ability of an ecosystem to endure disturbance and maintain structure, composition, and function that are characteristic of the system. Resistance may be reduced as departure from current VCC increases, especially for some ecosystems (e.g., mixed conifer-frequent fire forest, ponderosa pine forest, pinyon-juniper grassland).
- **Resilience**: The ability of an ecosystem, following disturbance, to regain structure, composition, and function that are characteristic of the system on a timespan consistent with its successional patterns. Resiliency may be reduced as departure from current VCC increases especially for some ecosystems (e.g., mixed conifer-frequent fire forest, ponderosa pine forest, pinyon-juniper grassland).

According to the assessment, all of the watersheds within the SFMLRP area have a composite vulnerability score of "Moderate" (U.S. Forest Service 2015b). The CCVA was integrated within the 2022 forest plan through the development of desired conditions for ERUs and other plan components describing vegetation and other resource management. Implementing the SFMLRP aligns with plan direction and was proposed based on a purpose and need for increasing resistance and resilience on the landscape, which is of importance within watersheds that are classified as having moderate to high vulnerability to climate change.

CARBON SEQUESTRATION

Forests play an important role in carbon sequestration, which is the direct removal of CO_2 from the atmosphere through biologic processes, such as forest growth. Carbon sequestration by forests mitigates GHG emissions by offsetting losses through removal and storage of carbon. Over at least the past several decades, temperate forests have provided a valuable ecosystem service by acting as a net sink of atmospheric CO_2, partly offsetting anthropogenic emissions. In 2011, in the conterminous U.S., CO_2 uptake by forests offset approximately 16% of our national total CO_2 emissions. Keeping forests as forests is one of the most cost-effective carbon storage measures. Restoration—bringing badly disturbed forests and grasslands back to producing a full range of environmental services—is another (U.S. Forest Service 2022b).

Carbon stocks are estimated by linear interpolation between Forest Inventory and Analysis survey years for the seven ecosystem carbon pools: aboveground live tree, below-ground live tree, understory, standing dead trees, down dead wood, forest floor, and soil organic carbon. Total forest ecosystem carbon stored in the Southwestern Region decreased between 1990 and 2013, with 584 teragrams (Tg[8]) in 1990 and 551 Tg in 2013. During this period, the Santa Fe National Forest generally increased in ecosystem carbon stocks (Black et. al, 2022; U.S. Forest Service 2021e; USDA 2015a). A quantitative assessment of forest carbon stocks and the factors that influence carbon trends (management activities, disturbances, and environmental factors) for the Santa Fe National Forest is available in the project record (Black *et al.,* 2022).

Roughly 34.5% of the carbon stocks on the Santa Fe National Forest are stored in above-ground, live woody vegetation (> 1 inch diameter), with the remaining 65.5% of carbon stored in soil, organic matter on the forest floor, roots, snags, course woody debris, and small understory vegetation (Black *et al.,* 2022). Each ERU within the Santa Fe National Forest contributes differently to biomass carbon stocks based on its spatial extent, vegetation community composition and structure, and ecosystem dynamics. Generally , relative contributions to carbon stocks are lowest in grassland and shrubland ERUs, with increasing contributions by woodland and forest ERUs, respectively. Total estimated 2020 existing condition carbon sequestration in the proposed treatment units is 743,627 tons (U.S. Forest Service 2021e).

3.8.2 Environmental Consequences

Methods and Assumptions Used for Analysis

Relevant documents were reviewed to determine compliance with applicable legal, regulatory, and policy requirements and direction.

Forest Inventory Analysis (FIA) stand exams data were processed with the FVS to determine thinning treatment forest stand carbon sequestration. The FOFEM was used to estimate wildfire and treatment fuel loading and carbon reduction, and smoke criteria air pollutant and GHG emissions.

The FVS model is used for analysis of the No Action Alternative and Proposed Action in the SFMLRP Silviculture Report. The model uses FIA plot data and provides analysis about changes to forest stand carbon over time based on modeling of forest stand growth and biomass changes and the effects of Proposed Action thinning/mastication and prescribed burning treatments. The FIA data and FVS model analyze total stand carbon loading, including ground/surface biomass (below ground live/dead, litter and duff, coarse woody debris), shrubs, living trees, and dead trees.

The following assumptions were used when developing analysis for the alternatives:

- Currently, FOFEM provides quantitative fire effects information for smoke emissions, among other things. FOFEM default fuel-loading inputs were based on SFMLRP ERUs' values. The smoke emissions modules were used for this analysis (Appendix A of U.S. Forest Service 2021e).
- Air quality emissions from toxins known to be present in smoke, such as metals (including mercury, radionuclides, and byproducts of accelerants), would not be expected to approach federal or state ambient air quality standards or result in long-term public health impacts; therefore, these were not analyzed.
- Fugitive dust from roadwork would not be expected to approach federal or state ambient air quality standards. Impacts from these types of emissions were not directly modeled. Fugitive dust is likely to last for a very short period of time (a few months rather than years), and the dust would be isolated to very small areas and would not pose a threat to visibility or air quality standards.
- Vehicle emissions and emissions associated with the operation of equipment (such as chainsaws and chippers) associated with roadwork, mechanical treatments, thinning, and harvesting of forest products would be locally confined and temporary. Equipment exhaust emissions would not be expected to negatively affect ambient concentrations.
- Ozone concentrations from prescribed fire (under the Proposed Action) would not be expected to approach federal or state ambient air quality standards.

Indicators

Table 3.31 presents the resource condition indicators and measures for assessing effects.

Table 3.31. Resource Condition Indicators and Measures for Assessing Effects

Issue	Indicator or Measure
Air Quality	Emissions (tons $PM_{2.5}$, PM_{10}, NO_x) Visibility: Qualitative
Climate Change and Carbon Sequestration	GHG Emissions (tons CO_2, CH_4) Carbon Sequestration (tons)

SPATIAL AND TEMPORAL CONTEXT FOR EFFECTS ANALYSIS, INCLUDING CUMULATIVE EFFECTS

The air quality spatial analysis area varied across the state of New Mexico, New Mexico Air Quality Control Region 4, and Santa Fe and San Miguel Counties, depending on the metrics analyzed. These areas are used for comparing SFMLRP emissions to state and local emissions. The temporal boundary is several days to weeks for prescribed burning emissions and annual for comparisons of SFMLRP emissions to state and local emission inventories.

The spatial boundary for analysis of climate change and carbon sequestration is the SFMLRP area and Santa Fe National Forest. The temporal boundary for GHG emissions and carbon storage is during and immediately post treatment. Climate change effects can be shown up to 2100, given the limitations of climate forecast models and research.

Alternative 1: No Action Alternative

AIR QUALITY AND SMOKE EMISSIONS

Under the No Action Alternative, the SFMLRP area would remain at risk of sustaining damaging, widespread wildfires. Compared with average annual estimated New Mexico wildfire emissions (Table 3.32 and Table 3.33), if the entire SFMLRP area were to burn in a wildfire, CP emissions would be 122% of $PM_{2.5}$, 162% of PM_{10}, and 100% of NO_x; GHG emissions would be 121% of CO_2 and 166% of CH_4. Wildfire emissions would be likely to cause smoke impacts that could exceed health standards in smoke-sensitive areas or populated communities surrounding the National Forest (U.S. Forest Service 2021e).

Wildfire emissions would release approximately 291,000 tons (or about 0.4%) of current, forest-wide sequestered surface and ground carbon (see Table 3.32) (U.S. Forest Service 2021e).

Table 3.32. Wildfire Fuel Loading, Surface and Ground Carbon Sequestration, Smoke, and GHG Emissions

Ecological Response Unit	Pre-Burn Fuel Load (tons)	Pre-Burn Carbon (tons)	Post-Burn Carbon (tons)	$PM_{2.5}$ (tons)	PM_{10} (tons)	NO_x (tons)	GHG CO_2 (tons)	GHG CH_4 (tons)
Colorado Plateau / Great Basin Grassland	15	8	1	0	0	0	22	0
Juniper Grass	482	241	47	1	1	12	0	0
Mixed Conifer – frequent fire	527,818	248,824	96,862	4,430	6,550	326	465,898	3,295
Mixed Conifer with Aspen	16,412	7,503	1,467	184	298	9	18,002	151
Pinyon Juniper Woodland	81,985	38,694	12,184	440	756	107	89,108	364
Ponderosa Pine Forest	300,081	136,140	38,416	1,693	2,881	421	345,910	1,373
Narrowleaf Cottonwood / Shrub	5,393	2,504	635	22	38	10	6,736	17
Upper Montane Conifer / Willow	248	118	35	1	2	0	293	1
Willow - Thinleaf Alder	15	7	2	0	0	0	18	0
Spruce-Fir Forest	19,682	9,074	2,495	173	279	15	20,677	140
Total	**952,132**	**443,113**	**152,144**	**6,945**	**10,806**	**900**	**946,665**	**5,342**

Note: Sums may not add up exactly due to rounding.

VISIBILITY

Under the No Action Alternative, wildfire smoke emissions would result in impacts to air quality within and near the project area. Management of wildfire could affect air quality and visibility on NFS lands and the surrounding areas depending on the location of the fire and wind conditions. When wildfires occur, they would burn unnaturally heavy fuels over large areas, causing adverse air quality and visibility impacts for as long as the wildfire event occurs. Visibility would likely be compromised during wildfires; depending on the size of the wildfire, visibility at nearby Class I areas, such as the Pecos Wilderness, could be adversely impacted. Reduced visibility could also indicate elevated levels of PM due to dust storms and wood-burning stove emissions during winter months (U.S. Forest Service 2021e).

Alternative 2: Proposed Action

AIR QUALITY

The amount of emissions emitted from a wildfire or prescribed fire is directly proportional to the amount of biomass combusted. Prescribed fire is typically lower intensity and consumes less biomass than wildfire, leading to lower per-unit-area emissions (Wiedinmyer and Hurteau 2010). Implementation of the Proposed Action would reduce future wildfire smoke emissions and air quality impacts and mitigate the potential long-term loss of stored carbon that could result from the occurrence of wildfire. In a comparison of wildfire emissions with prescribed fire emissions, Liu et al. (2017) found that airborne PM from wildfires is substantially larger than that associated with prescribed fires, likely due to differences in fire behavior and fuel conditions associated with each of these fires. Manual and mechanical fuel treatments and prescribed fire would have minimal impacts on air quality. Fuels management and preparation of the treatment areas for prescribed burning could improve the effectiveness of a response to unplanned wildfire by lowering fuel loading across the landscape, thereby resulting in beneficial impacts to regional air quality (U.S. Forest Service 2021e).

Smoke impacts could be minimized by timing and scheduling prescribed burns to be completed during periods of favorable atmospheric conditions. However, even with favorable atmospheric conditions, residences and other inhabited locations near areas being treated with prescribed fire could experience undesirable levels of smoke for periods lasting several hours (U.S. Forest Service 2021e).

During nighttime hours, smoke would settle into low-lying areas, such as valleys and canyons, which is where most communities are located. The smoke would settle more heavily into areas closest to the burn; The Santa Fe River gorge and Pecos River valley funnels nighttime smoke from fires burning in the Santa Fe Mountains down and into the Santa Fe and Pecos city areas and surrounding communities. Smoke would be heaviest in the early-morning hours. As daytime heating increases, smoke would begin to mix with upper-level air flows over a larger area, resulting in a lesser impact on localized areas. Smoke would decrease each day after initial burning but could last for several weeks after ignition; length would be based on fuel load, fuel moisture, and precipitation events (U.S. Forest Service 2021e).

The impact of smoke on local community members and visitors would depend on weather conditions, when fires are active, and an individual’s sensitivity to smoke. The U.S. Forest Service would take measures to manage smoke impacts resulting from prescribed fire following design features Air-1 through Air-6 (see Appendix C). Prior to implementing a prescribed fire, a prescribed fire plan would be written to follow the New Mexico Smoke Management Program. Prescribed fires would be carefully evaluated to consider smoke dispersal into nearby communities surrounding the Santa Fe Mountain. As a result, the effects on air quality from prescribed fire would be short term and localized near the prescribed fire area. The duration of the impact would coincide with the duration of prescribed burn activities (U.S. Forest Service 2021e).

Table 3.33 show project area smoke emissions estimates within selected ERUs for proposed thinning and prescribed fire treatments. The table shows pre- and post-burn fuel load, pre-and post-burn surface and ground carbon sequestration, CPs (PM_{10}, NOx) and GHG emission (CO_2, CH_4) (U.S. Forest Service 2021e).

Table 3.33. Thinning and Prescribed Burning: Fuel Loading, Surface and Ground Carbon Sequestration, Criteria Pollutants, and GHG Emissions

ERU	Pre-Burn Fuel Load (tons)	Pre-Burn Carbon (tons)	Post-Burn Fuel Load (tons)	Post Burn Carbon (tons)	PM2.5 (tons)	PM10 (tons)	NOx (tons)	GHG CO2 (tons)	GHG CH4 (tons)
Juniper Grass	430	215	84	42	1	1	1	614	0
Mixed Conifer – frequent fire	237,167	111,805	125,005	60,648	1,991	2,351	89	152,917	1,188
Pinyon Juniper Woodland	68,502	32,330	42,138	20,510	367	433	37	38,675	214
Ponderosa Pine Forest	110,778	50,258	28,363	14,182	625	740	90	79,641	358
Total	**416,877**	**194,608**	**195,590**	**95,380**	**2,984**	**3,525**	**218**	**271,879**	**1,760**

Note: Sums may not add up exactly due to rounding.

Table 3.34 compares the emissions from the proposed project (prescribed burning on 20,128 acres, thinning and prescribed burning on 17,238 acres, and the burning of thinned slash piles) with the No Action Alternative wildfire scenario (on 38,888 acres) (U.S. Forest Service 2021e).

Table 3.34. Comparison of Pre- and Post-burn Fuel Loadings, Pre- and Post-burn Carbon Sequestration, Criteria Pollutants, and GHG Emissions for the Proposed Treatments under the No Action Alternative

Treatment	Pre-Burn Fuel Load (tons)	Post-Burn Fuel Load (tons)	Pre-Burn Carbon (tons)	Post-Burn Carbon (tons)	$PM_{2.5}$ (tons)	PM_{10} (tons)	NOx (tons)	GHG CO_2 (tons)	GHG CH_4 (tons)
Prescribed Burn Only	493,404	261,365	231,873	126,493	4,229	4,231	271	331,129	2,093
Thinning and Prescribed Burning	416,877	195,590	194,608	95,380	2,984	3,525	218	271,879	1,760
Thinning Slash Piles	118,764	11,876	51,637	26,824	721	828	51	177,830	300
SFMLRP Project Total Emissions	**1,029,045**	**468,832**	**478,118**	**248,697**	**7,934**	**8,584**	**539**	**780,837**	**4,153**
No Action Wildfire Scenario	**952,132**	**304,092**	**443,113**	**152,144**	**6,945**	**10,806**	**900**	**946,665**	**5,342**

Note: Total project emissions may not sum exactly due to rounding.

Table 3.35 shows annual CP and GHG emissions from the Proposed Action over 10 to 15 years. The thinning treatments would produce slash fuels (rearranging biomass from canopy fuels to surface fuels) thereby increasing surface fuel loads. The wildfire scenario produces more particulates overall compared with the Proposed Action prescribed burning scenario and more PM10 because prescribed burning produces a more efficient combustion of fuels. Compared with the estimated annual New Mexico emissions from prescribed burning (see Table 3.35) the SFMLRP would emit approximately 16% to 24% of estimated New Mexico PM2.5 emissions, 15% to 22% of PM10 emissions and 7% to 10% of NO_x emissions on an annual basis (U.S. Forest Service 2021e).

Table 3.35. Annual SFMLRP Criteria Pollutant and GHG Emissions over 10 and 15 Years

Project Implementation	$PM_{2.5}$ (tons)	CP PM_{10} (tons)	NOx (tons)	GHG CO_2 (tons)	GHG CH_4 (tons)
Annual Emissions Over 10 years	793	858	54	78,083	415
Annual Emissions Over 15 years	529	572	36	52,056	277

VISIBILITY

Prescribed burning associated with the Proposed Action would produce less smoke emissions than wildfire emissions associated with the No Action Alternative. The reduction in wildfire risk and potential smoke emissions would likely result in a long-term benefit to visibility conditions. Prescribed fire events would be planned in such a way as to avoid or minimize impacts to visibility. Therefore, adverse impacts to Class I areas would be unlikely to occur from the Proposed Action's prescribed fire activities (U.S. Forest Service 2021e).

Climate Change and Carbon Sequestration

The climate impact of implementing the SFMLRP would be related to the additional GHG emissions it is predicted to emit into the atmosphere through prescribed burning and thinning treatments. The emissions related to project activities predominantly originate from the burning of organic materials and to a lesser extent from the fuels used for fire ignitions or to power mechanical equipment. Compared to the estimated annual New Mexico GHG emissions from prescribed burning, the SFMLRP would emit approximately 11% to 17% of New Mexico CO_2 emissions and 15% to 22% of New Mexico CH_4 emissions on an annual basis (U.S. Forest Service 2021e).

CARBON SEQUESTRATION

A study by Meigs et al. (2009) found that mixed-conifer forests that burned at low to moderate intensities (prescribed fire conditions) were a slight carbon sink and those that burned at high intensity were a large carbon source. In their evaluation of ponderosa pine forests, they found that stands burned at low severities were carbon neutral, with moderate-severity stands a source and high-severity stands a large source.

Forest restoration increases resistance and resilience to damaging forms of disturbance such as drought stress and wildfire effects that are considered outside the natural range of variability. The Proposed Action would increase ecosystem resistance and resilience that could result in carbon sequestration beyond the 10- to 15-year project duration. Even though practices such as thinning and prescribed fire may release carbon in the short term, they focus growth and sequestration for the future on trees that are at lower risk and/or are more resilient to disturbance. Previous research in southwestern ponderosa pine forest has demonstrated that a restored condition that is maintained by regular surface fire can store more carbon than a fire-suppressed condition when the effects of unplanned wildfire are incorporated (Hurteau 2017). Appropriate forest management and protection can substitute lighter, strategically placed, and more recoverable emissions for disturbance emissions that would be more severe, extensive, and less reversible (U.S. Forest Service 2015b). Because live trees continually sequester carbon and are a more stable carbon sink than dead biomass left on the site, treating stands is preferred for long-term mitigation of atmospheric carbon levels (Vegh et al. 2013).

Additionally, reducing tree density through thinning has been shown to reduce drought stress and increase growth and carbon sequestration relative to a fire-suppressed condition during dry periods (Hurteau

2017). The restoration of forest structure and the maintenance of that structure with regular surface fire helped sustain the forest carbon sink, even under an increasingly hotter climate (Hurteau 2017).

Post treatment, sequestered carbon would be reduced due to biomass removal and prescribed burning. New and accelerated forest stands growth, especially in large trees, would offset the removed or released carbon. In addition, the post-treatment forest stands would be more resilient and able to resist adverse wildfire effects, which would allow for more steady carbon sequestration over time (Wiedinmyer and Hurteau 2010). Compared to current SFNF carbon stocks, the Proposed Action's prescribed burning would reduce surface and ground forest carbon by 0.3% (U.S. Forest Service 2021e).

Cumulative Effects

See Table 3.1 for a list of present and reasonably foreseeable future actions considered for cumulative effects on air quality and climate. The spatial boundaries for analyzing the cumulative effects for air quality and climate is the same area analyzed for direct/indirect impacts above, as it represents a reasonable region in which air quality and climate conditions, when assessed in combination with other cumulative actions, could be impacted if the proposed project were implemented. The temporal boundary for analyzing the cumulative effects is 15 years because restoration methods are anticipated to have taken effect in that time period.

Recent past, ongoing, and planned fuel reduction projects would continue to occur on adjacent tribal lands and other federal, state, and private lands surrounding the project area. These would have cumulative impacts on air quality. Restoration activities would occur on adjacent public lands, including, but not limited to, the Aztec Springs (Phases 2 and 3), Aspen Ranch, Vigil Grant, Hyde Memorial State Park, and Santa Fe Municipal Watershed projects, would also increase ecosystem resilience in the analysis area. Combined, these projects would treat up to approximately 34,000 acres over the next decade. Mechanical treatments and other restoration activities on the adjacent state lands and tribal lands would further increase long-term air quality benefits as a result of reduced risk of wildfire as well as improved forest health, which could improve the forest's resiliency in a changing climate.

Because of the small windows of opportunity for burning that exist in the analysis area, it is possible that the federal, state, tribal, and private landowners would have concurrent or consecutive prescribed fires. The effects of these burns on air quality would be reduced to the extent possible through coordination with the New Mexico Environment Department. Fire hazard would be further reduced throughout the area.

Summary

The impact of smoke on local community members and visitors would depend on weather conditions, when fires are active, and an individual's sensitivity to smoke. The U.S. Forest Service would take measures to manage smoke impacts resulting from prescribed fire following design features Air-1 through Air-6 (see Appendix C). Prior to implementing a prescribed fire, a prescribed fire plan would be written to follow the New Mexico Smoke Management Program. The U.S. Forest Service prescribed burning operations would only be conducted with authorization from the State after air quality meteorologists determine that atmospheric conditions would adequately disperse smoke away from smoke-sensitive areas and that air pollutant concentrations would not exceed health standards (U.S. Forest Service 2021e).

The reduction in wildfire risk and potential smoke emissions would likely result in a long-term benefit to visibility conditions. Prescribed fire events would be planned in such a way as to avoid or minimize impacts to visibility. Therefore, adverse impacts to Class I areas would be unlikely to occur from the Proposed Action's prescribed fire activities (U.S. Forest Service 2021e).

Under the Proposed Action, post prescribed burning sequestration would reduce forest carbon by 0.3%. A comparison of existing 2020 conditions and Proposed Action carbon sequestration in 2070 shows that the Proposed Action would increase carbon sequestration within thinning treatment units (from 743,627 tons to 770,451 tons). Compared to the No Action Alternative, implementation of the Proposed Action would have an insignificant effect on existing, forest-wide carbon stocks, but would increase the resiliency and sustainability of carbon sequestration to future disturbances and the effects of climate change.

Implementation of the Proposed Action would increase ecosystem resistance and resilience to adverse climate change effects. Decreasing the risk of significant damage from drought and wildfires outside the natural range of variability would stabilize carbon sequestration.

3.9 Recreation

The focus of this section is to analyze the following question:

How would the proposed treatments impact public access for recreation in the project area?

3.9.1 Affected Environment

The project area offers many recreational opportunities to the residents of north-central New Mexico as well as national and international visitors that are drawn to Santa Fe County. Table 3.36 shows there are approximately 74 designated recreation sites within the project area, most of which are within the Española District. There are also approximately 254 recreation sites within the two U.S. Forest Service Districts available to the public outside the project area.

Table 3.36. Recreation Sites on NFS Land within the Project Vicinity

Site Type	Pecos/Las Vegas Ranger District	Española Ranger District	Within SFMLRP Area
Campgrounds	10	4	3
Campsites	174	52	38
Group campgrounds	2	0	0
Picnic areas	5	2	3
Picnic sites	24	19	19
Boating sites	0	0	0
Fishing access	3	0	0
Trailheads	15	15	9
Nordic ski areas	0	2	1
Downhill ski areas	0	1	1
Total	**233**	**95**	**74**

Source: U.S. Forest Service (2021d)

The northern portion of the project area is within the Española Ranger District of the SFNF and is within a short drive from the city of Santa Fe. Many consider it to be like a “backyard” recreation area, and therefore it receives high use year-round. Most popular recreation activities within the northern portion of the project area include camping, picnicking, hiking, mountain biking, and horseback riding in the summer. During the winter months there is alpine skiing at Ski Santa Fe, Nordic skiing on area roads and trails, as well as snowshoeing and hiking where practical.

The south project area is within both the Española Ranger District and the Pecos/Las Vegas Ranger Districts. Recreation is not as high use as the north side, and access is not as easy. There is no paved highway to the recreation sites like the NM 475 highway on the north side, but instead just a couple of Forest dirt roads open in travel. Private property without easements along the boundary of the Forest also limits access. Most popular recreation activities within the southern portion include four-wheel driving, mountain biking, hiking, and horseback riding. Winter recreation is much more limited in the southern portion due to lower elevation and less snowpack.

The New Mexico SH 475 corridor out of Santa Fe to Ski Santa Fe is the primary and most popular access to U.S. Forest Service recreation opportunities (Table 3.37). From south to north along SH 475, the following recreation sites can be found on NFS lands:

- Chamisa Trailhead
- Little Tesuque Picnic Area
- Black Canyon Campground
- Black Canyon Trailhead
- Borrego Bear Wallow Trailhead
- Big Tesuque Campground and Trailhead
- Pacheco Road intersection with Highway 475 (dispersed camping and trailhead access mostly outside of project area)
- Aspen Vista Picnic Area and Trailhead
- Vista Grande Overlook
- Aspen Basin Campground and Trailhead
- Ski Santa Fe Ski Area (one of the major skiing areas in the region)

In the western portion of the SFMLRP Area, the following recreation sites can be found:

- Aspen Ranch Trailhead
- Winsor Trailhead
- En Medio Trailhead

In the southern portion of the SFMLRP Area, the following recreation sites can be found:

- Arroyo Hondo Trailhead (at the south end of the proposed road closure)
- Glorieta Baldy Lookout and picnic area
- Forest Road 375 from I 25 to Glorieta Baldy
- Forest Road 50A from Highway 50, through private land and terminating 3.5 miles north of the private land
- Numerous non-motorized roads and U.S. Forest Service System Trails and user-created trails starting near the Glorieta Conference Center

Table 3.37. Recreation Areas and Opportunities in the SFMLRP Area

Location Name	Type of Recreation Opportunities Provided	Estimated Number of Users Accommodated	Recreation Setting
Little Tesuque	Picnic Area	10	Roaded Natural
Black Canyon	Campground and Trailhead	42	Roaded Natural
Big Tesuque	Campground and Trailhead	7	Roaded Natural
Aspen Basin	Campground and Trailhead	6	Roaded Natural
Aspen Vista Picnic	Picnic Area and Trailhead	5	Roaded Natural
Vista Grande Overlook	Observation Point	10	Roaded Natural
Borrego Bear Wallow	Trailhead	4	Roaded Natural
Aspen Ranch Trail Head	Trailhead	4	Roaded Natural
Ski Santa Fe	Winter Ski Resort	660 acres, 86 runs	Rural
Glorieta Baldy	Picnic Area	4	Roaded Natural
Chamisa	Trailhead	4	Roaded Natural
Winsor	Trailhead	4	Roaded Natural
En Medio	Trailhead	4	Roaded Natural
Apache Canyon	Trailhead	6	Roaded Natural

Integral to both prior and current recreation planning processes is the use of a tool called the Recreation Opportunity Spectrum (ROS). This is a system used to inventory and classify public lands according to physical, social, and managerial settings, which combine to offer specific types of recreational opportunities. As the name implies, such settings range across a spectrum of opportunities from primitive, where motorized use does not occur and facilities are non-existent or minor in extent, to urban, where opportunities are vehicle dependent and facilities may be extensive. The ROS stratifies and defines classes of outdoor recreation environments. The spectrum may be applied to all lands, regardless of ownership or jurisdiction. The ROS divides recreation settings into six broad categories: urban, rural, roaded natural, semi-primitive motorized, semi-primitive non-motorized, and primitive (U.S. Forest Service 1986).

The project area consists of rural, roaded natural, semi-primitive motorized, and semi-primitive non-motorized classifications, as shown in Table 3.38. Most of the project area falls into the Semi-Primitive Non-Motorized and Semi-Primitive Motorized classifications. Along SH 475 corridor, all the recreation sites are within the Roaded-Natural classification, with the exception of Ski Santa Fe which falls into the Rural classification due to heavy winter use for downhill skiing. The southern portion of the project area primarily falls into the Semi-Primitive Motorized classification (U.S. Forest Service 2021h).

Table 3.38. ROS Classification of the Project Area

Recreation Opportunity Spectrum Classification	Description	Acres in Project Area
Semi-Primitive Non-Motorized	• A setting that has an area of primitive roads or trails that are not open to motorized use; is generally at least 2,500 acres in size; and is between 0.5 and 3 miles from all roads, railroads, or trails with motorized use. • Access is via nonmotorized trails or nonmotorized primitive roads or cross-country. • Low contact frequency with other visitors. • High probability of solitude; natural-appearing environment.	22,511
Semi-Primitive Motorized	• A setting that has an area that allows motorized use, is generally at least 2,500 acres in size, and is at least 0.5 mile from a constructed or maintained road for use of highway-type vehicles. It is within 0.5 mile of primitive roads or trails used by motor vehicles. • Access is via motorized trails or primitive roads or cross country, where terrain and regulations permit. • Low to moderate contact frequency with other visitors. • Environment may have moderately dominant alterations, but these do not dominate views from trails or primitive roads in the area.	17,160
Roaded-Natural	• A setting in an area that is within 0.5 mile of a better-than-primitive road. Access is primarily via conventional motorized use on roads. • Contact frequency with other users may be low to moderate on trails and moderate to high on roads. • Environment is natural appearing as viewed from visually sensitive roads and trails.	9,632
Rural	• Predominantly a culturally modified setting where the natural environment has been substantially modified, i.e., structures are readily apparent, pastoral or agricultural or intensively managed wildland landscapes predominate as viewed from visually sensitive roads and trails. • Access is primarily via conventional motorized use on roads. • Contact frequency with other users may be moderate to high in developed sites and moderate away from developed sites.	657
Primitive	• This ROS class acreage is associated with a boundary error with the adjacent Pecos Wilderness.	23
Private land	• No ROS class is identified for private land.	522

3.9.2 Environmental Consequences

Methods and Assumptions Used for Analysis

The analysis to determine potential impacts to recreation is based on existing management and data from SFNF and Española Ranger District. GIS data were also used in this analysis and include recreation settings and designated recreation sites. The anticipated changes to the resource condition indicators (based on the proposed SFMLRP) provide the basis for assessing impacts.

For this analysis of impacts to recreation:

- The analysis area for recreation impacts includes the area shown on in Figure 3.18. These are areas which can be reached by automobile from the Santa Fe area within 15 to 30 minutes of travel in normal traffic.
- Short-term impacts are those that occur during implementation of the project and may linger for a few days to a few weeks after the project
- Long-term impacts are those that would last more than a month following implementation of the project.

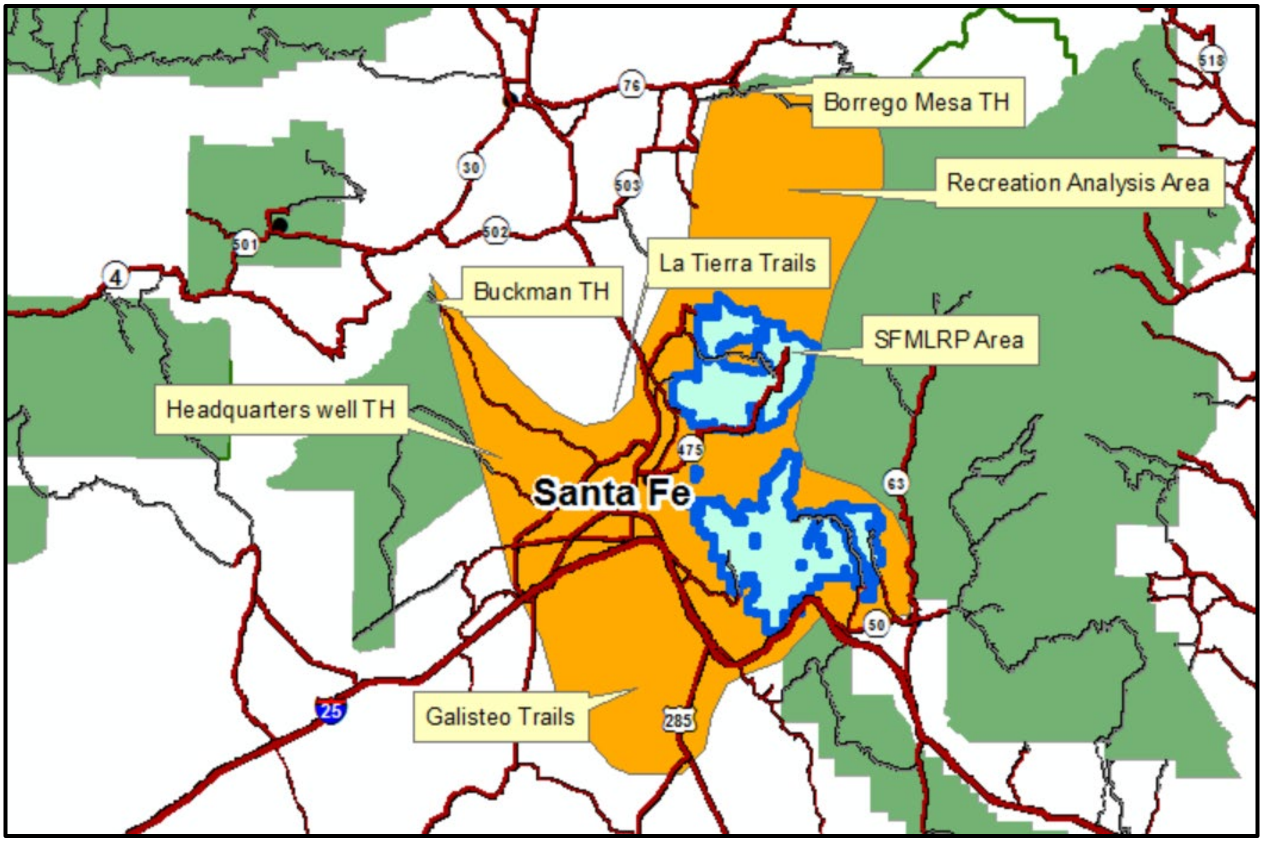


Figure 3.18. Recreation analysis area.

Table 3.39 provides a breakdown of these indicators and the measures used in the predicting and characterizing the analysis.

Table 3.39. Resource Indicators and Measures for Assessing Effects

Resource Element	Resource Indicator	Measure (quantify if possible)
Recreation Setting	Changes to the existing recreation setting	Qualitative assessment of restoration within ROS classes
Recreation Opportunities	Changes (loss of or creation of) to the current available recreation opportunities and activities	Qualitative assessment of restoration method's impact to recreation opportunity
Desired Recreation Experiences	Changes (diminishment or improvement) to existing recreation values and quality	Qualitative assessment of restoration method's impact to recreation desired experiences

Alternative 1: No Action Alternative

Under the No Action Alternative, there would be no forest treatments; therefore, no short-term adverse impacts would occur to recreation from trail closures or visual impacts due to thinning operations, smoke arising from prescribed burns, or riparian restoration work, as described under the Proposed Action. Recreation would continue as it has in the past.

Long-term adverse impacts to recreation under the No Action Alternative, would be likely due to the increased chance of catastrophic fire which could affect most of the trails in the area. Research and recent wildfires in New Mexico have demonstrated the negative effects severe wildfire can have on recreation. In areas of wildfires, trails would have to be rebuilt over time as conditions stabilize and as restoration activities become safe to conduct. Falling trees would increase user risk and make maintenance more difficult. For example, as a result of the Cerro Grande and Las Conchas fires in Los Alamos County, fire impacts led to multiple reconstruction events for some trails due to post-fire flooding, relocation for some trails was required, and other trails were never practical to rebuild. The desirable character, scenery, shading, and "feel" of trails were often degraded in the long term. Wildfire-affected trails and dispersed camping opportunities may become more dangerous on windy days due to standing dead trees. Thorny primary species that increase after wildfires, like New Mexico Locust, may make trails more difficult, uncomfortable, or even unusable without continuous pruning and maintenance.

Under the No Action Alternative, there would be no impacts to the existing recreation setting, opportunity, and existing recreation experiences beyond those that are already occurring in the project area if no catastrophic wildfire occurred. If a catastrophic wildfire did occur, major impacts to the recreation setting, opportunity, and existing recreation experiences would be anticipated to occur, as happened in the major wildfires in Los Alamos County in 2000 and 2011.

Currently, the U.S. Forest Service has limited resources to maintain existing recreation opportunities (e.g., clearing down trees from trails and roads) or to mitigate threats such as the impacts to recreation facilities such as campgrounds, trailheads, roads, and parking areas that could result from a wildfire, windthrow, or other disturbance. Current maintenance is limited to removing existing vegetation threats as time and resources are available and depending on the risk to health and human safety, as opposed to maximizing resources by treating larger areas to restore forest resiliency, as described in the Proposed Action. Piecemeal treatments that only address immediate hazards would not reduce the risk for large catastrophic wildfires, and often do not address recreation site hazards such as dead and dying trees that block safe passage on forest roads and trails. The threat of uncharacteristically severe wildfire, windthrow, or other disturbance would continue to increase with ongoing, non-landscape-scale vegetation management activities under the No Action Alternative. Furthermore, continuing to only remove site-specific vegetation as time and resources permit will perpetuate current unhealthy forest conditions and could even increase the rate of forest health decline.

Research and recent wildfires in New Mexico have demonstrated the negative effects severe wildfire can have on recreation (such as the Cerro Grande, Las Conchas, and Hermit's Peak – Calf Canyon fires where fire impacts included closing developed campgrounds and trails to public use and created safety hazards to dispersed recreation opportunities such as camping). If the SFMLRP analysis area or portions thereof were closed due to wildfire, recreation users would be required to seek alternative locations to pursue the same activity. This could lead to overcrowding in nearby areas of Santa Fe National Forest, resulting in potential resource damage and undesirable recreational experiences.

Barring a severe wildfire, windthrow, or other disturbances, there would be no loss or creation of recreation opportunity. Recreation opportunities and activities would continue as they do today, and the quality of the recreation experiences, as well as the desired recreation experiences as outlined in the Forest Plan, would be expected to remain (U.S. Forest Service 2021h).

Alternative 2: Proposed Action

The project area is used extensively for recreation. The Proposed Action would result in both adverse and beneficial impacts to recreation. Short-term adverse impacts to trail users, campers, and recreation special uses could occur during implementation of forest treatments due to temporary closures of certain areas, noise from treatment crews, vehicles, and equipment, periods of smoke from prescribed burns, and the sight of remaining material piles or treatment residuals. This is particularly the case for those settings classified under the ROS as semi-primitive motorized and semi-primitive non-motorized (such as driving for pleasure on routes and hiking/biking on trails), where such treatment activities would be more evident and recreationists would expect to encounter such disturbances less often. The effects would be transient as the recreationist moves past the work area (or vice versa). Maintaining vegetation clearances or establishing new forest health practices around recreation infrastructure may result in changes to the recreation setting that people have grown accustomed to, but these changes would be intended to benefit the recreation setting in the long term. It would likely be perceived as an improved aesthetic change by most (U.S. Forest Service 2021h). Project-specific design features Rec-1 through Rec-13 and Scen-3 through Scen-10 (see Appendix C) would mitigate impacts to recreation.

The Proposed Action activities may restrict the use of favorite trails for the short term, mostly from controlled burns. Mechanical vegetation thinning would not directly affect trails unless the trail itself was used for access by motorized vehicles. Ridgeline firelines may turn into user-created trails, causing tribal concerns and user safety issues. Where trails are used as access for treatments, they will require reclamation to restore the trail to a sustainable single track. Long term, the visual changes due to mechanical thinning, prescribed fires, riparian vegetation, and closed roads will not be noticeable to the majority of recreation users. There are few vantage points from trails and facilities where these treatment areas can be seen in an overview aspect.

Camping primarily occurs along designated roads and trails. Campsites, both developed and dispersed, could be temporarily closed or restricted for public safety, including prescribed burning, heavy equipment use, slash piles, and even hand vegetation thinning. Campers in dispersed sites while work is underway would experience indirect noise and visual effects similar to those already described.

There is the potential that outfitters and guides may need to adjust their trip locations and/or days to avoid treatment areas, smoke, and/or congestion and noise associated with these operations. Advanced notice of these activities could be given to minimize the inconvenience to guides and their clients

Based on the U.S. Forest Service's recent monitoring of recreation user numbers and experiences at the Black Canyon campground, which was treated in 2018, potential impacts to campground users would be short-term during treatment implementation activities (from noise, human presence). Periods of smoke and noise could also affect quality of experience. No long-term impacts to the Black Canyon campground users occurred due to the implementation of project-specific design features, which are very similar to the design features identified for SFMLRP (see Appendix C).

Restoration activities conducted in areas that are not near developed sites or adjacent to routes or trails (i.e., in semi-primitive non-motorized areas) under the Proposed Action would have beneficial effects on the recreation setting. A healthier forest (i.e., mixed conifer, ponderosa pine, and pinyon-juniper forests with natural plant and animal demographics, maximum structural and spatial heterogeneity of vegetation, maximum productivity and biodiversity, and intact ecosystem processes and functions) would be more open in character than the current landscape and would offer more dispersed recreation opportunities like hunting, hiking, and wildlife viewing.

Current ROS settings would not change under the Proposed Action, and all restoration activities would be conducted such that the Proposed Action would conform to the ROS classifications delineated in the Forest Plan.

The desired recreation experiences of the project area would not change since the restoration methods would be conducted so that they minimize impacts to recreation experiences and would be in compliance with the Forest Plan. Restoration methods would only preclude recreational desired experiences temporarily during surface-disturbing restoration work; once activities were completed, the desired recreation experiences would continue, subject to public safety concerns.

VEGETATION THINNING TREATMENTS

Manual and mechanical vegetation treatments, particularly those that involve heavy equipment or machinery, have the potential to adversely impact recreation opportunities and experiences; these impacts would be site specific and short term. Project design features Rec-2 through Rec-7 (see Appendix C) would limit the use of equipment on trails and restrict impacts when practical to non-peak seasons, when recreation use is anticipated to be at its lowest and would minimize any indirect effects such as cut stumps adjacent to trails that might cause tripping hazards for hikers and bike tire punctures for bikers. Additionally, the design feature Rec-13s would impose a one-year limit and minimum distance of 150 feet for any vegetation piles placed within areas managed for a scenic integrity objectives (see Appendix C). The proposed treatments could lead to changes around a campground or dispersed camping and may lead to reduced potential for fuelwood. Yearly hazard tree mitigation may offset this for developed campgrounds since such trees are often made available as fuelwood.

USE OF PRESCRIBED FIRE

When prescribed fires occur in the vicinity of trails, these trails will not be open for use during the fire burning period which could be from a day to a week at most. Trail users would be displaced to other trails for a period of time. Recreation users even in adjacent areas could experience periods of increased smoke and lessened visibility, but given the broad area of the analysis area, there would almost certainly be somewhere in the vicinity where the trails would not be affected. The same is true for other recreation activities such as camping in campgrounds or dispersed camping, and motorized driving. Following a prescribed burn there may be sections of burn visible from trails, dispersed camp areas and Forest Roads. These burn areas would mostly be short-term impacts unless the burn was very severe in a particular area. Depending on the time of year, the blackened areas would revegetate and the burn would not be immediately noticeable. The Proposed Action goal is to prevent the large-area severe burns where there would be a stand-replacing fire resulting in long-term impacts.

Ridgetop firelines may be constructed prior to implementation of prescribed fires. If these are left in place post-fire, they might be used by hikers/bikers and become additional user-created trails. This may create conflict with the overall trail planning for the area and may encourage erosion. Design feature Rec-12 is intended to mitigate impacts from unauthorized recreational use of firelines (see Appendix C).

There is the potential that outfitters and guides may need to adjust their trip locations and/or days to avoid restricted areas, smoke, and/or congestion and noise associated with these operations. Advanced notice of these activities could be given to minimize the inconvenience to guides and their clients.

RIPARIAN RESTORATION TREATMENTS

The Proposed Action would not adversely impact the availability of trails; however, recreation users may experience some effects on recreation activities in both the short- and long-term. The Rio en Medio Trail, Winsor Trail, Apache Canyon trail, and Big Tesuque Trail are the trails that follow streams within the project area. Trail users may come across workers in the area during their hike or bike ride and may notice minor changes in vegetation or new fencing. The fencing would be designed such that trails would not be impeded. If a gate is installed in a fence, mountain bikers and equestrians may be inconvenienced in their travels with a need to stop, get off their bikes or horse, and negotiate a passage. Fencing design feature Rec-8 (see Appendix C) would minimize the need for hiker/biker passage through a fence.

ROAD CLOSURE

The Proposed Action includes closure of 1.5 miles of Forest Service Road 79W near Arroyo Hondo, which would have some impact on the Arroyo Hondo trailhead access in this area. It would require all users to park at the Arroyo Hondo trailhead rather than continue driving up the rough road, which many prefer to hike anyway.

Cumulative Effects

See Table 3.1 for a list of present and reasonably foreseeable future actions considered for cumulative effects on recreation. The spatial boundaries for analyzing the cumulative effects on recreation resources is the same area as the Recreation Analysis Area, as it represents a reasonable region in which recreation settings, existing recreation opportunities and activities, and desired recreation experiences, when assessed in combination with other cumulative actions, could be impacted if the proposed project were implemented. The temporal boundary for analyzing the cumulative effects is 15 years because restoration methods are anticipated to have taken effect in that time period.

The past uses in the cumulative effects analysis area have had a direct effect on the recreation settings, as described in Affected Environment and Environmental Consequences sections. Historic proliferation of mining and ranching roads, the establishment of federal, state, county, and private lands, and community development have all shaped the recreation opportunities, settings, and desired experiences in the cumulative effects analysis area.

Watershed protection, fuels reduction, restoration, and habitat improvement activities all have the potential, when considered with the Proposed Action, to cumulatively impact the recreation setting. The cumulative impact of the actions listed in Table 3.1 to the recreation setting would be adverse, minor, and short-term. This is particularly true in areas classified as semi-primitive non-motorized because actively managed, intensive actions (as opposed to passive actions such as natural revegetation) like watershed protection, fuels reduction, restoration, and habitat improvements typically involve activities that are inconsistent with the objectives of a semi-primitive non-motorized area. While this impact may also occur in rural, roaded-natural, and semi-primitive motorized areas, actively managed, intensive actions are mostly consistent with these ROS classifications. In addition, the issuance of Forest-wide temporary and priority SUPs for non-motorized activities would result in a beneficial cumulative impact to recreation because it would expand recreation activities within the analysis area.

As described above under direct and indirect impacts from the Proposed Action, adverse impacts to recreation settings would be most apparent during and immediately after SFMLRP treatments. Over the next 10- to 15-year period, approximately 18,000 acres would be treated using vegetation thinning and 38,000 acres would be treated using prescribed fire in the SFMLRP area. From the projects listed in Table 3.1, recreational experience could be impacted on approximately 7,000 additional acres, resulting in a cumulative impact to recreational experiences within 25,000 to 45,000 acres over the long term. As with the Proposed Action, the actions listed in Table 3.1 would be implemented over time, and therefore would not occur all at once. Users can be expected to pursue similar or other opportunities outside the SFMLRP treatment areas but within the cumulative effects analysis area. They can also be expected to return to the areas over time inside the SFMLRP area once restoration activities are successfully completed. Over time, the cumulative impacts to recreation setting would be beneficial, and the recreation setting would be protected and enhanced.

Implementation activities of the Proposed Action and other reasonably foreseeable actions may detract from the recreational opportunities. For example, areas affected by controlled burns/fires derived from the actions provided in Table 3.1 would likely render the setting less aesthetic for recreation activities, thus affecting the recreation experience. These would be individually minor, but collectively moderate, particularly in areas where the Proposed Action and other reasonably foreseeable projects provided in Table 3.1overlap and are not spread out over large areas. However, with the Proposed Action being staggered over long periods of time and the actions listed in Table 3.1 not all conducted concurrently, the cumulative effects on recreation opportunities and experiences would be substantially decreased (i.e., recreational opportunities would continue in areas not being actively restored). Therefore, recreational opportunities would not be lost permanently (i.e., restoration activities may only take a few days) and no recreational opportunities would be completely precluded, even during implementation of the Proposed Action or actions listed in Table 3.1 at any time since all recreation opportunities identified within the cumulative effects analysis area are able to be pursued in adjacent and similar areas.

Off-highway vehicle riding may have more opportunities available as a result of the Proposed Action and other reasonably foreseeable projects provided in Table 3.1, particularly projects that create new access roads (both temporary and permanent), such as fuels reduction and forest restoration projects. These projects often encourage increased off-highway vehicle use through “curiosity,” and users may use the access roads of the Proposed Action and other reasonably foreseeable projects’ access roads to view the activities and/or sites (subject to existing New Mexico off-highway vehicle laws and regulations).

The desired recreation experiences of the project area would not change when considered in the context of the other actions listed in Table 3.1, since the U.S. Forest Service would ensure those projects would also be conducted in a manner that minimizes impacts to recreation experiences and in compliance with the Forest Plan.

In summary, the cumulative impacts to recreation would be the incremental increase in people, projects and activities within a very high-use recreation area. Impacts by the SFMLRP would be minimized by design features, timing, and the abundance of alternative areas where people can participate in their recreational activity of choice. It should be noted that although the project would increase a ‘presence of activities’ in the area during implementation, the desired result would be an environment that would be more sustainable over time and would allow recreation activities to continue, and even grow. Without the SFMLRP, there could be increased risk of catastrophic fire that would change, limit, and even eliminate much of the recreation activities that are currently enjoyed.

Summary

- **Recreation settings**: Recreation settings are not expected to change in a way that is striking and dramatic to the average user long term. There could be short-term interruptions to the recreation sites and corridors such as debris, smoke, noise, workers, fencing and even burn areas near the trail corridors. Long term, users may notice a slightly more open forest in and around the recreation trail corridors and facilities such as campgrounds, dispersed camping and picnic areas. The Proposed Action is expected to help preserve these recreation site surroundings and corridors from the potential of catastrophic fire where the recreation settings would be severely impacted.
- **Recreation opportunities/activities**: Short term, recreation activities might be temporarily restricted or degraded in quality in some areas for short periods of time due to prescribed burns, smoke, noise, fencing, or vegetative removal. Long term, the recreation opportunities would not be impacted. Hunting is not expected to be noticeably impacted by the Proposed Action other than temporary closing of some areas during implementation, and migration of animals to other areas in the short term. The more open habitats created by the Proposed Action might even draw more deer and elk to these areas. The Proposed Action should lessen the chance for catastrophic fire around these recreation sites and trails. Should a catastrophic fire occur, there would be great impact to recreation opportunities and activities. Trails would disappear and need to be reconstructed in a severely burned environment where most topsoil could be lost.

- **Desired recreation experiences**: Short term, desired recreation experiences would be impacted only through short-term closures of select trails and dispersed camping within a prescribed burn. There are no plans to close campgrounds and picnic areas due to the Proposed Action. Long term, the desired recreation experiences would not be impacted by the Proposed Action other than lessening the chance of catastrophic fire in the future which would have a huge impact on desired recreation experiences.

3.10 Scenery

The focus of this section is to analyze the following question:

How would the proposed treatments impact the scenic quality of the project area?

3.10.1 Affected Environment

The SFMLRP area is located in the southwestern Sangre de Cristo Mountains east of Santa Fe on the Española and Pecos/Las Vegas Ranger Districts. The landform of the project area is mountainous terrain with highly dissected slopes, sharp, angular ridgetops, and deep V-shaped canyons. Features of glaciation, such as cirques, glacial troughs, deep valleys, and sharp combs, are evident.

The lowest elevations are approximately 6,500 feet. The highest elevations extend to approximately 11,000 feet. Glorieta Baldy, Atalaya Mountain, Aspen Peak, Thompson Peak and Shaggy Peak are prominent mountains located within the project area. The summits of Lake and Tesuque Peaks are adjacent to the northeast project boundary with their western slopes located within the project area. In the north project area, mountain summits rise above the tree line. Mountains do not rise above tree line in the south project area.

Landforms and vegetation combine for dramatic landscapes comprised of pine and spruce forests, aspen turning golden colors in the fall, and high mountain meadows occurring on steep mountains and in river canyons with high cliffs and rock outcrops. Fall color viewing of vivid gold aspen is popular. Aspens at Big Tesuque are a draw for visitors.

Landscapes are viewed to varying degrees from different locations and subsequently differ in their importance. To assist scenic inventory and analysis, this importance is ranked by concern levels (USDA 1995). Concern levels are a measure of the degree of public importance placed on the landscapes viewed from travelways and use areas. Primary travelways and use areas that are concern level 1, are nationally or regionally important locations associated with recreation and tourism. Secondary travelways and use areas that are concern level 2, are locally important locations associated with all types of use including recreation and tourism. Table 3.40 lists the areas and travelways within the project area that attract a high number of people with concern for scenery. Table 3.41 lists the travelways and use areas that have concern levels of 1 or 2 adjacent to the project area. Figure 3.19 identifies the concern level the areas and travelways with the project area.

Table 3.40. Travelways and Use Areas with Concern Levels 1 or 2 within the Project Area

Name	Concern Level	Feature Type	Project Area
Aspen Basin	1	campground	north
Aspen Cabin	1	administrative site	north
Aspen Ranch Trailhead	1	trailhead	north
Aspen Vista Trailhead	1	trailhead	north
Bear Wallow Trailhead	1	trailhead	north

Name	Concern Level	Feature Type	Project Area
Big Tesuque	1	campground	north
Chamisa Trailhead	1	trailhead	north
Glorieta	1	picnic site	south
Glorieta Baldy	1	lookout	south
Norski	1	cross-country ski area	north
numerous roads	1 and 2	roads of various maintenance levels	south
numerous streams	1	streams	north and south
numerous trails	1 and 2	trails	north and south
Pacheco Canyon Road	1	road	north
Santa Fe Ski Area	1	alpine ski area	north
Vista Grande Overlook		observation site	north
Winsor National Recreation Trail	1	trail	north
SFNF Scenic Byway	1	road	north

Table 3.41. Travelways and Use Areas with Concern Levels 1 or 2 Adjacent to the Project Area

Name	Concern Level	Feature Type	Project Area
Santa Fe	1	city	north and south
Glorieta Conference Center	1	community	south
Pueblo of Tesuque	1	community	north
La Cueva	1	community	south
Rio en Medio	1	community	north
Canada de Los Alamos	1	community	south
El Camino Real	1	national scenic byway	north
Historic Route 66	1	national scenic byway	north and south
Santa Fe Trail	1	national scenic byway	south

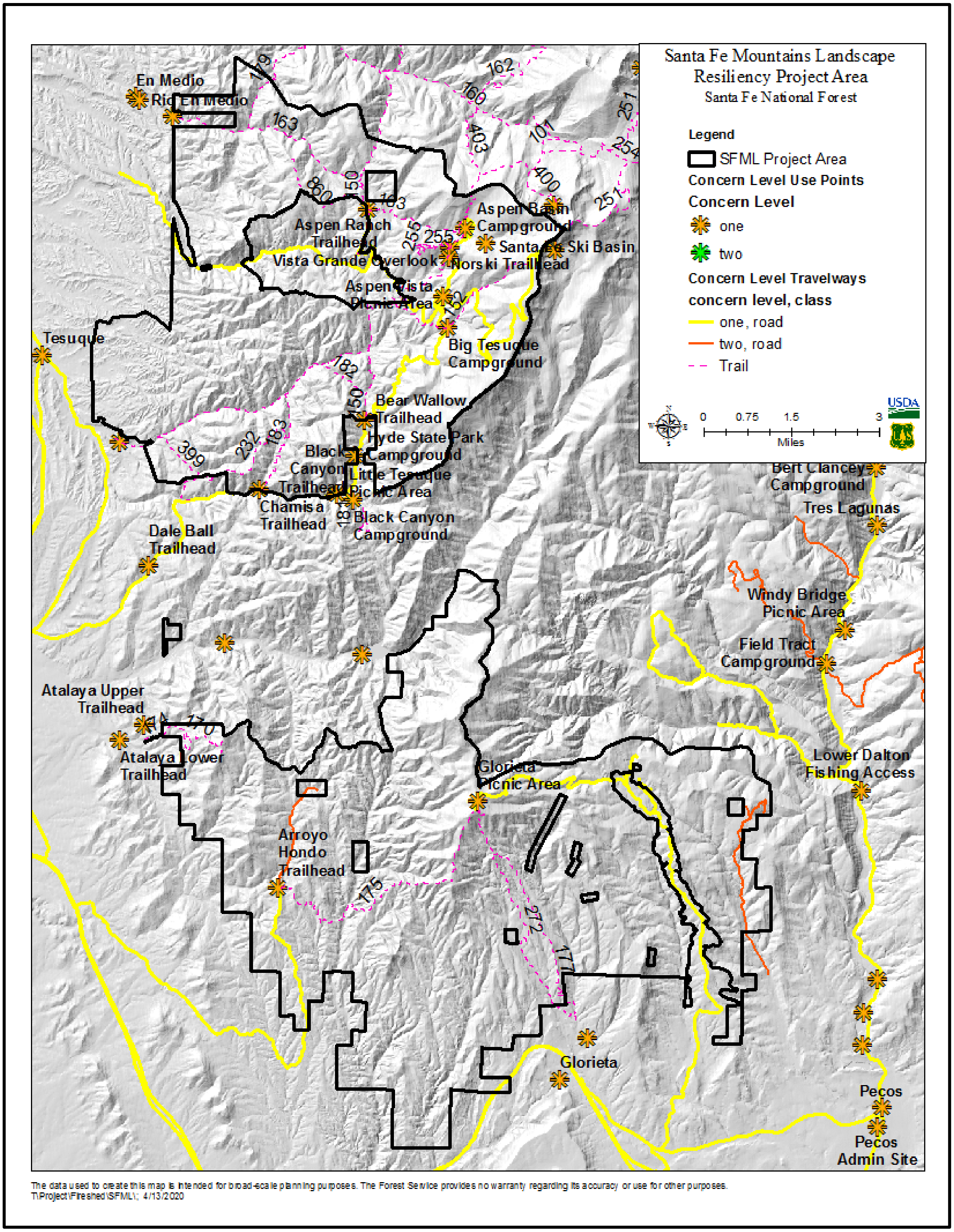


Figure 3.19. Travelways and use areas that attract large numbers of people with concern for scenery both within and adjacent to the project area.

3.10.2 Environmental Consequences

Methods and Assumptions Used for Analysis

This section includes a description of the methods and data used in this analysis. The analysis contained in this section is qualitative and assesses whether the effects of the alternatives on desired scenic integrity objectives identified in the 2022 Forest Plan and used as measurement indicators. An Enterprise Program Landscape Architect conducted a site visit in September 2019 to collect information, learn the project area scenic character, and review existing scenic integrity.

SCENERY MANAGEMENT SYSTEM

The SFNF uses the Forest Service Scenery Management System to determine the importance of scenery and identify scenic resources as they relate to people. Scenic integrity measures the degree to which the scenic character attributes are intact. Scenic integrity objectives are defined by degrees or levels of alteration from the existing scenic character and the intent is to achieve the highest scenic integrity possible and move toward the desired conditions. The Forest Plan uses four scenic integrity objectives (SIO) and how they relate to public perceptions of scenery as described in the table below.

Table 3.42 Scenery Management System scenery integrity objectives and how they relate to public perceptions of scenery.

Scenic Integrity Objective	Public Perceptions of Scenery
Very high	Unaltered; scenic character is intact; naturally evolving
High	Appears unaltered; alterations to scenic character may be present but are not evident; naturally appearing
Moderate	Slightly altered; alterations are subordinate to scenic character being viewed (scenic character is dominant, not the alteration); relatively naturally appearing
Low	Moderately altered; alterations begin to dominate the valued scenic character being viewed.

VISIBILITY ANALYSIS AND VISUALIZATIONS

To gauge visibility of the project area, viewsheds were analyzed by utilizing a composite map and site-specific viewsheds that analyze specific popular observation points. Viewshed studies were executed with the visibility tool in ArcGIS version 10.5.1. More information about the viewshed analysis and the results can be found in the SFMLRP Scenic Effects Analysis Report.

For several key vista points within and adjacent to the project area, visualizations in Adobe Photoshop were created (see Figure 3.20, Figure 3.21 and Figure 3.22 under Alternative 2: Proposed Action). Visualizations are an artistic interpretation of what the Proposed Action would look like from select observation points. The artist used the prescription, desired future conditions, and methods to render in a photo montage what the vegetation is expected to look like post implementation.

See pages 1–6 of the scenery specialist report for analysis assumptions used to analyze impacts to scenery (U.S. Forest Service 2021i).

Alternative 1: No Action Alternative

Under the No Action Alternative, scenery would continue in the same state as existing conditions, which are the accumulation of past land management actions and natural processes. The vegetation within the project area would continue to have high and moderate departure from the fire regime groups (as discussed in the affected environment section).

The majority of vegetation types within the project area would continue to be dense stands of even-aged trees. The texture of this forest would continue to be mostly closed, coniferous canopy with few openings. The forest conditions would continue to have middle ground (0.5 to 4 miles distance zone) and background (4 miles to the horizon) views that are even texture with little visual variety. Foreground views (0 to 0.5 mile) would continue to be obscured by dense stands of even-aged trees.
For visualizations of the existing scenic conditions of the project area, see Figure 3.20, Figure 3.21 and Figure 3.22 Under the No Action Alternative, most noticeable changes to scenic conditions across the landscape would occur through natural processes such as wildfires, wind events, or flooding. These natural disturbances will continue to shape the vegetation and landform features of the landscape, affecting the overall sustainability of the scenic character.

Wildfires which burn with mixed severity have fewer impacts to scenic character than those that burn with high severity, which result in greater tree mortality. Low and mixed severity fires are part of the characteristic landscape by maintaining visual variety and opening sightlines. Under the No Action Alternative, there would be a higher chance of uncharacteristic, stand-replacing wildfire because no treatments would occur to reduce the fuel loading and associated wildfire risk in the area. This type of wildfire could cause post-fire flooding and erosion risk, and insects and disease outbreaks in the project area. People often describe feelings of loss due to the noticeable changes in scenic character and sense of place from uncharacteristic large-scale disturbance. “In general, natural forest disturbances that result in extensive areas of dead or dying trees (Haider and Hunt 2002; Ribe 1990) such as the destruction of the forest by fire or flooding are perceived negatively (Fanariotu and Skuras 2004; Gobster 1994, 1995)” (cited in Ryan 2005:17). The risk of uncharacteristic fire severity would continue to increase within the project area. Forest structure would continue to be somewhat homogenous and would continue to be dominated by a single age class. Forests would lack the desired level of diversity in structure, composition, and density. Forest susceptibility to insects and disease (e.g., bark beetles and mistletoe) would continue to increase. Ultimately, the landscape would not be moved toward desired conditions, and as such, the no action alternative would not meet the purpose and need for the project (U.S. Forest Service 2021i).

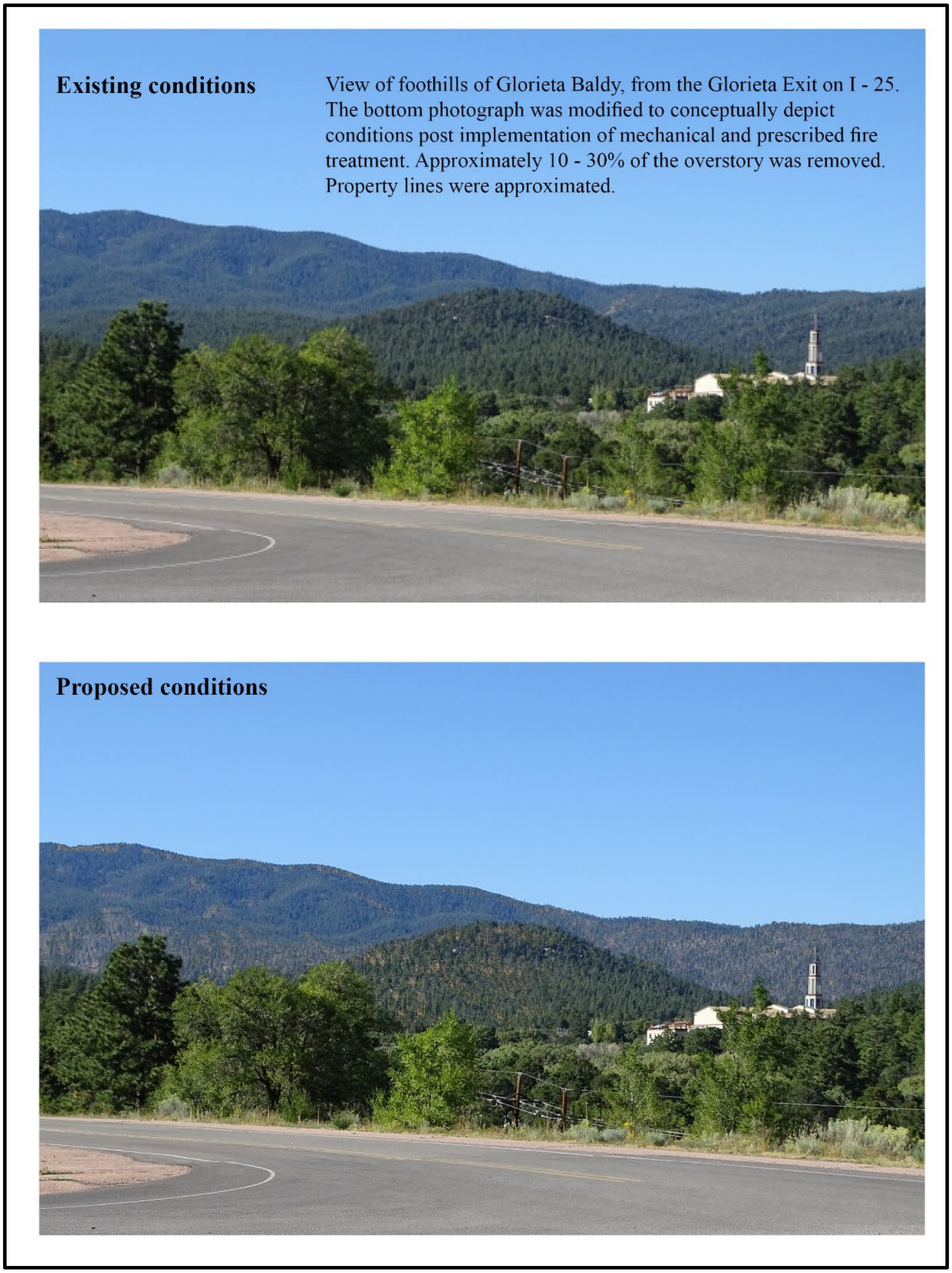


Figure 3.20. Visualization of the Proposed Action from an observation point at the Glorieta Exit from I-25. Proposed forest treatments are within the middleground (0.5–4 miles) and background distance zones (4 miles–horizon) in ponderosa pine forest.

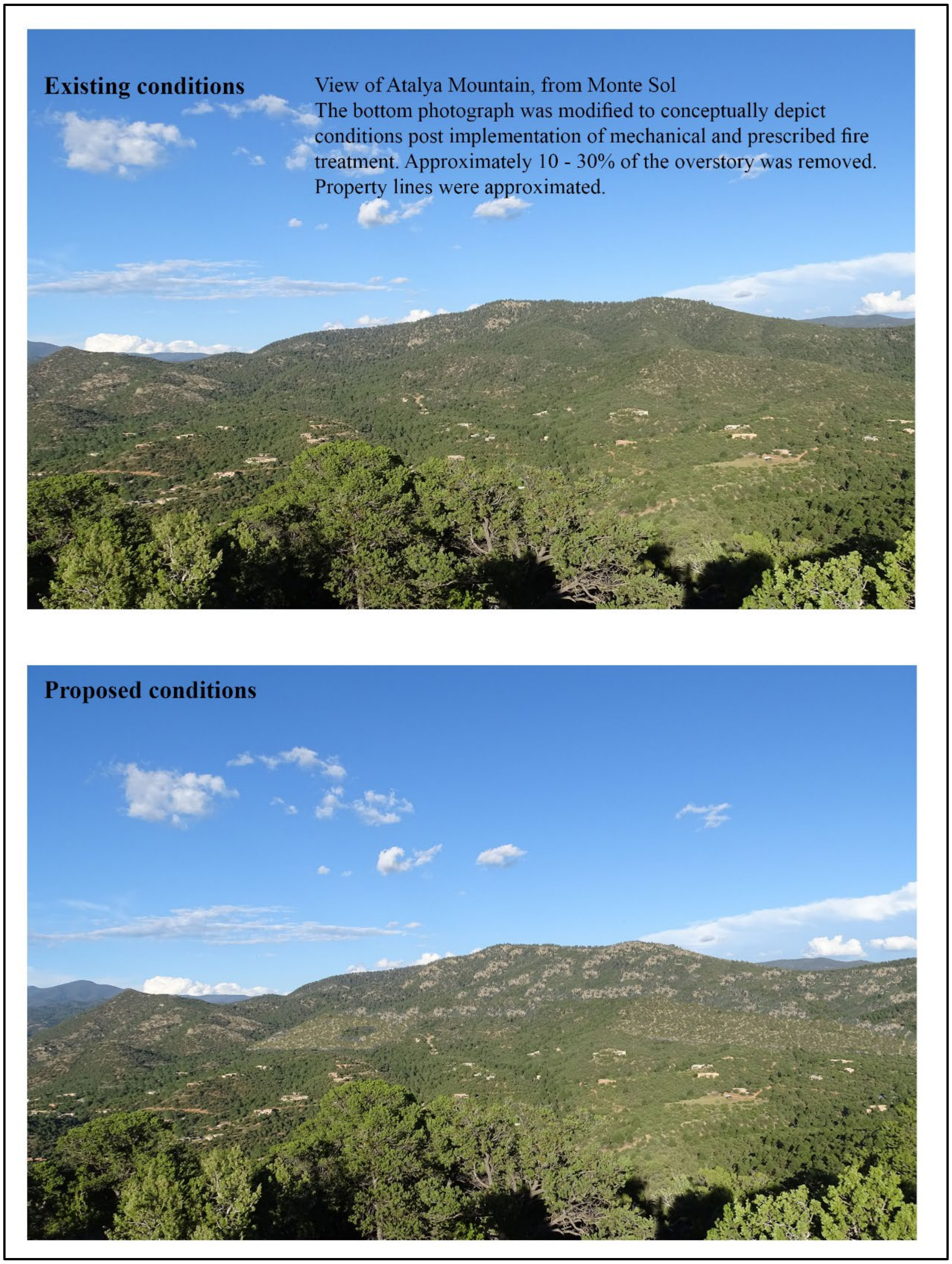


Figure 3.21. Visualization of the Proposed Action from an observation point from the summit of Monte Sol. Proposed forest treatments are within the middleground (0.5–4 miles) in pinyon-juniper woodland and ponderosa pine forest.

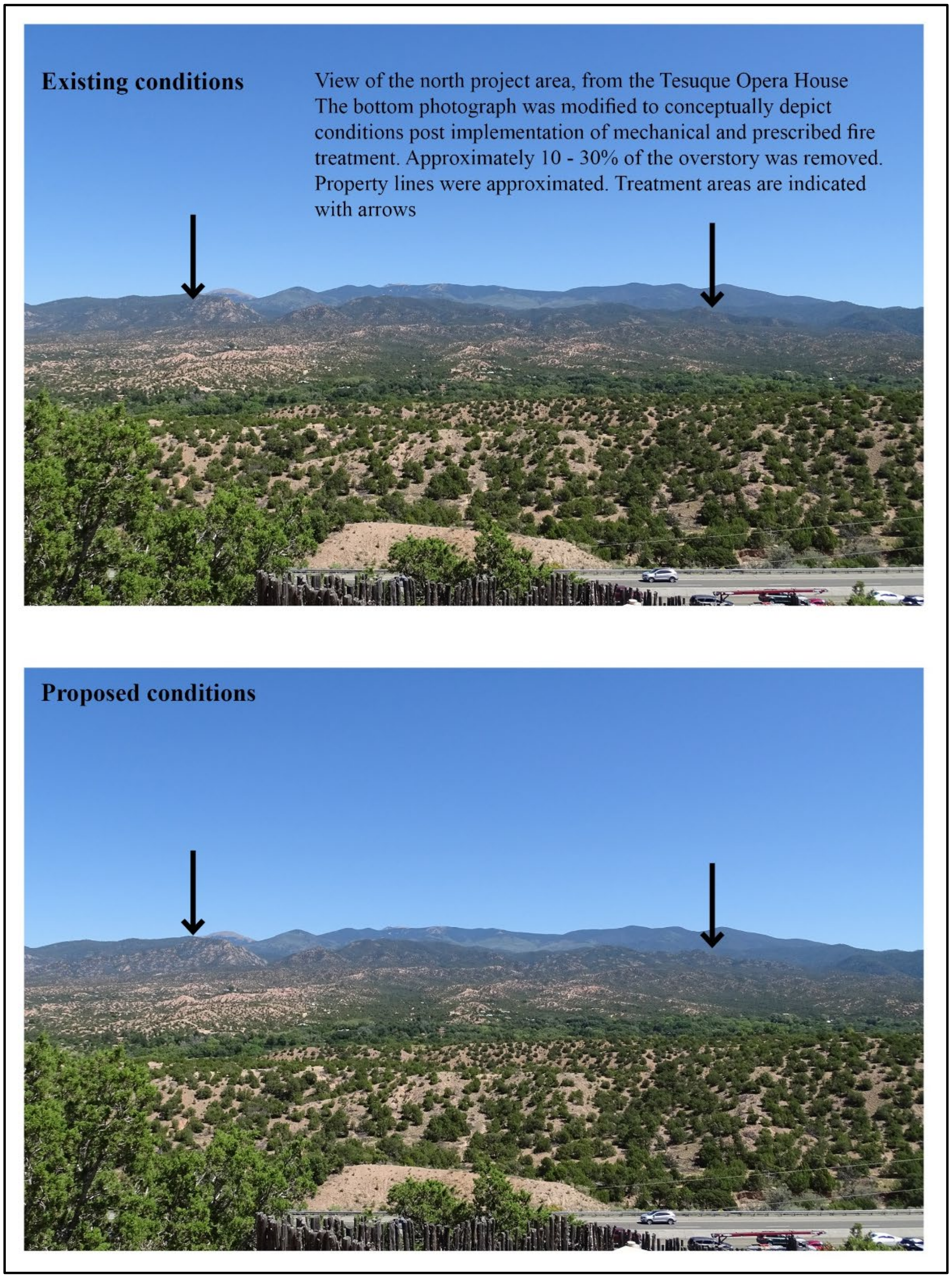


Figure 3.22. Visualization of the Proposed Action from an observation point at the Tesuque Opera House. Proposed forest treatments are within the middle ground (0.5–4 miles) and background distance zones (4 miles–horizon) in multiple vegetation types.

Other natural disturbances in the project area include insect and disease, with mortality or damage from western spruce budworm, spruce beetle, western balsam bark beetle, fir engraver, Douglas-fir beetle, and other vectors that cause aspen defoliation—to name a few. Aspen defoliation can greatly affect scenery since fall colors are a big part of the economy and tourism industries. Ponderosa pine–dominated types have insect and disease risk with mortality or damage from western pine beetle. Pinyon-juniper vegetation types include mortality and damage from bark beetles (USDA 2015a). Under the No Action Alternative and in the absence of fire, disturbance to vegetation caused by insect and disease is expected to increase. As the density of trees increase, so will competition for limited resources. This competition will stress trees, creating conditions for disease and insect outbreaks. For more information see the fuels and silviculture reports.

Alternative 2: Proposed Action

Vegetation treatments may have short-term effects of ground disturbance, stumps, and slash, but in the long term, with the application of design features, may provide for some preferred scenic settings, such as visual access into the forest, greater vegetative diversity, larger trees, and an herbaceous ground cover (Gobster 1994).

In the long term, the removal of some trees, dependent on scale and intensity of treatment, may improve scenic character and make scenic attributes more resilient to uncharacteristic large-scale disturbance. Healthy, fire-resistant vegetation (such as vegetation conditions allowing fires to move through the landscape without doing major damage and that recover relatively quickly from fire) is important for long-term scenic quality and scenic character resilience. Hence, healthy and resilient forest environments that recover relatively quickly would maintain or improve scenic character which maintains sense of place attachment and opportunities to connect with nature.

Proposed activities, although they may have some short-term impacts on scenery, also may begin to move the landscape toward the desired scenic character. Desired scenic character is defined as the appearance of the landscape to be retained or created over time (U.S. Forest Service 1995). Effects that would move the vegetation toward the desired scenic character are beneficial to scenic resources in the long term. These beneficial effects are often realized over a longer period of time but lead to the lasting sustainability of valued scenery attributes. For example, tree thinning may have short-term effects of ground disturbance, stumps, and slash, but in the long term, may provide visual access into the forest and promote large tree growth and a smooth herbaceous ground cover. In the long term, the removal of some trees, dependent on scale and intensity of treatment, may be a beneficial effect for scenery.

Desired scenic character often includes and is linked to preferred visual settings. Gobster (1994) summarizes visually preferred settings as having four common attributes: large trees; smooth, herbaceous ground cover; an open midstory canopy with high visual penetration; and vistas with distant views and high topographic relief.

Visual access, or how far one can see into a forest, is also a preferred scenic setting (Ryan 2005). The degree of visual access varies throughout the project area, depending on the amount of understory vegetation present in the forest. Forests with dense vegetation allow very little visual access into the forest. In the long term, scenic resources would have higher scenic quality if visual access is achieved or enhanced.

In the long term, burning typically increases the diversity of texture, color, vegetative size classes, and distribution across the landscape. In the short and long terms, underburning often creates a smooth, herbaceous ground cover, a preferred visual setting. Less severe natural disturbances, such as low burn severity areas where understory burns but most mature trees are not killed, result in preferred forests over time (Taylor and Daniel 1984).

The public often judges the ecological health of a forest by appearance. Hill and Daniel (2008) found that acceptance of restoration activities may be contingent on public perceptions of aesthetics and knowledge of ecological benefits. People prefer landscapes with large trees, openings, and varied spatial distribution of vegetation that provide views through the site and into the landscape (Brush 1979). Recreationists prefer uneven-aged forest landscapes over even-aged, dense stands (Brown and Daniel 1984, 1986, 1987; Ryan 2005). Restored forests meet these scenery preferences, suggesting greater public acceptance and support (U.S. Forest Service 2013).

VEGETATION THINNING TREATMENTS

Approximately 18,000 acres of NFS lands in the project area would be subject to vegetation thinning. There would be short-term direct and indirect moderate visual impacts from the sights of slash and equipment while the treatments occur. As vegetation is removed, sight lines from roads, trails, streams, recreation use areas and other viewing platforms would be opened up to allow for more distant foreground views. Thinning would add also add variety to the existing condition of even-textured, closed coniferous canopy in middleground and background distance zones. Treatments would be incremental over time as discrete areas within the project area undergo thinning annually.

During implementation, the scenic character of the project area would temporarily change to a more working landscape setting due to the equipment and vehicles used for thinning and the sights of slash, tree stumps, and woody debris. This would be localized to 750 acres of the project area each year.

In the short term, aspects of scenic quality and visitor experiences would simultaneously be diminished and enhanced within the thinned areas. The existing scenic integrity in these areas would temporarily diminish as vegetation recovers from the thinning. In foreground views, stumps and slash of cut vegetation would be evident. Visual access, the distance an observer can see from a viewing platform such as road, trail or other observation point, would immediately increase, adding depth and variety to the view. In middleground views, there would be noticeable contrasts of line, form and color between treated and untreated areas. The existing condition would be enhanced by adding visual variety to the even-texture of the closed coniferous canopy. Effects of thinning would be expected to be muted in the background distance zone but texture and color contrasts between treated and untreated areas could be evident.

High scenic integrity objective would be met with one year of implementation with the application of the following best management practices and design features. Scen-1 through Scen-10, Rec-9 through Rec-11, and Rec-13 (see Appendix C).

In the long term, there would be beneficial direct and indirect effects from the vegetation thinning. Thinning would extend the depth of view (visual access) into the forest and create openings for potential vistas. The thinning would allow for larger trees to grow and thrive. Open space would be created, most residual slash and all equipment would be gone. In the long term, the project would move toward or achieve desired scenic integrity objectives, , the character landscape would be enhanced, and the quality of the recreation experience would improve.

USE OF PRESCRIBED FIRE

Approximately 38,000 acres of NFS lands in the project area would be subject to prescribed fire treatments. The following assumptions are made about prescribed fire treatments.

There would be short- and long-term direct and indirect fire effects such as blackened trunks and burn scars on leave trees. These would introduce dark, contrasting colors into the landscape that can last 10 to 15 years. The understory vegetation is expected to fill in and help blend the fire effects into the landscape over time. Dead and dying woody vegetation from low-intensity burning would be a short-term impact, as it typically takes 3 to 5 years to recover. However, herbaceous vegetation would recover more quickly, typically within one growing season. Low-intensity smoke causes a temporary lack of visibility and obscures scenery. This type of smoke only occurs only for the duration of the burn and dissipates into the atmosphere, as opposed to smoke from an uncharacteristic wildfire, which can heavily impact air quality and landscape visibility for weeks.

In the short term, some people might perceive recently burned areas negatively. However overall, the scenic character would be enhanced by prescribed fire. The effects of prescribed fire are mostly natural appearing as fire typically burns in a mosaic pattern with mixed severity. This creates a mosaic of blackened tree boles, green trees, red needled trees and pockets of dead trees. This mosaic would introduce visual variety into the existing condition of even-textured closed coniferous canopy by creating openings. Openings would occur when mixed severity causes groups of trees to die. In foreground views, these openings would introduce areas that have more solar gain (sunny and not shaded by canopy). These sunny areas would break up the forest with vegetation dominated by herbaceous and shrub species. The openings in middleground and background views will add visual variety to the texture and color to the existing condition of closed coniferous canopy. The form of the openings will be natural appearing because they would have been created by fire.

While prescribed fire is mostly natural appearing because it mimics natural process, preparation for prescribed fire units can detract from existing scenic integrity. Firelines constructed to contain prescribed fire, can adversely affect scenic quality. This occurs when firelines create linear features that contrast with the natural appearing scenic character.

Scenic integrity would be expected to diminish in the short term as the project is implemented. However, changes to the scenery would be incremental as discrete areas would be implemented annually. Scenic integrity would be expected to be enhanced in the long term through the introduction of forest openings, visual variety and increased visual access. Design features Scen-1 through Scen-10 would ensure that the desired scenic integrity objective is met within two years.

In the long term, prescribed fire treatments would have beneficial impacts and enhance the scenery resource and therefore the characteristic landscape. The removal of ladder and ground fuels not only reduces risks from wildfires but also helps to produce the conditions that people find attractive, such as open, park-like conditions. By improving forest conditions to accommodate low or moderate fires, the risk of stand-replacing fires is reduced. Low-intensity surface fire may have subtle long-term visual impact on the landscape, whereas high-intensity stand-replacement wildfires would have long-term, conspicuous visual impacts. Ecologically, the treatments would increase the landscape’s resilience to wildfire, disease, and drought and would ensure that the scenic integrity would be enhanced and met.

RIPARIAN RESTORATION TREATMENTS

In areas where riparian vegetation is in poor condition, or is being encroached with conifers, thinning, prescribed burning, and revegetation plantings would occur. Conifers would be cut and removed from riparian areas to allow riparian vegetation to thrive and expand. Non-native species such as Siberian elm, Russian olive, salt cedar, and Tree of Heaven would be cut and removed. Prescribed fire would be introduced in low intensity to reduce understory fuels and promote riparian vegetation growth. Native species such as willow, cottonwood, alder, grasses and forbs would be planted if natural regeneration is determined to be insufficient following conifer and non-native species removal. 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.

Effects from proposed riparian restoration treatments would be similar to thinning treatments except more localized. The treatments are located in incised canyons (drainages). This renders the treatments mostly visible in foreground views and not in other distance zones. Tesuque Creek treatments would be adjacent to and visible from the Winsor National Recreation Trail. Design features would ensure scenic integrity objectives are met.

The removal of non-native species and encroaching conifers would increase visual access in the short term. However, the recruitment of riparian species would further reduce visual access, but increase habitat for wildlife, such as colorful neotropical migrant birds.

If fencing is deemed necessary, to exclude browsing animals, the design feature Scen-2 would ensure scenic integrity objectives are met (see Appendix C).

ROAD CLOSURE

There would be no expected effects on scenery from closing the 1.5-mile section of the 79W road, other than it would enhance the non-motorized, quiet and solitude of the viewing platform's recreation experience.

Cumulative Effects

The cumulative effects analysis for the Proposed Action includes projects located within analysis area occurring within the past decade and future decade. The area was chosen because this is the approximate distance from where other projects, including the SFMLRP, could be seen.

Past activities that created the current conditions include grazing, the evolving forest management practices related to fire suppression, drought, disease and insect infestations, dispersed and developed recreation, and utility corridor clearing. The cumulative effects of past management activities are visible as the existing condition. Vegetation management practices, fire suppression, and grazing have resulted in the current mostly even-aged forest structure, overstocked conditions, and sparse understory trees, shrubs, grasses and forbs.

Present and future activities (see Table 3.1)such as vegetation management, fuels management, utility corridor clearing and new utility corridors, and other management activities (e.g., noxious weeds treatments would be most visible from highly used roads and trails and prominent viewpoints, such as high-elevation areas or summits..

Cumulative impacts for the analysis area would be of the same type and duration as direct and indirect impacts but would occur on a greater scale. In the short term, these impacts would be adverse but in the long term, they would be beneficial.

Vegetation treatments, such as the extraction of forest products would have the highest likelihood to have substantial impacts to the scenery within the cumulative effects analysis area. However, projects on U.S. Forest Service lands would be designed to meet the 2022 Forest Plan desired conditions. Scenic integrity would be expected to diminish in the short term when projects overlap in space and time. However, projects are designed to restore ecological conditions, scenic integrity would be enhanced in the long term.

Summary

There would be short-term effects from thinning of vegetation, most notably stumps and slash. Firelines in preparation for prescribed fire would impose linear features on a natural appearing landscape. However, design features would assuage effects and ensure compliance the 2022 Forest Plan scenery desired conditions. Prescribed fire, that mimics the natural process of mixed-severity fire, would create openings within the existing condition of even-age, even-texture, closed coniferous canopy. Openings would enhance the views from within the project area out and from outside the project in. In the long term, scenery would be enhanced through increased visual variety and access.

It is anticipated that with the application of design features and based on professional judgement that the scenic character in the SFMLRP project area will be maintained and enhanced in the long term.
The beneficial effects described above will occur throughout the project area resulting in long-term scenic quality and scenic character resilience.

3.11 Heritage Resources

The focus of this section is to analyze the following question:

How would the proposed treatments impact heritage resources in the project area?

3.11.1 Affected Environment

Cultural resources represent the tangible and intangible evidence of human behavior and past human occupation. They may consist of archaeological sites; historic-age buildings and structures; traditional use areas; and cultural places that are important to a group's traditional beliefs, religion or cultural practices. These resources are non-renewable and, depending on the nature of the resource, can be particularly sensitive to management practices, such as the proposed landscape restoration treatments. The potential impacts to tribal and traditional uses are discussed below in EA Section 3.12.

The SFMLRP Phase 1 Literature Review (Campbell and Comstock 2021) revealed 93 previously recorded archaeological sites within the project area resulting from 34 valid surveys for various projects. Table 3.43summarizes the number of sites belonging to each site type. Data from each site were analyzed to determine a site's fire sensitivity and treatment recommendation. It should be noted that in many cases, these data are outdated and incomplete. An accurate assessment of site fire sensitivity will require a ground-truthing exercise to verify fuel loads, fire-sensitive features, and pre-burn treatment needs at individual sites. Approximately 44% (n=47) of the previously recorded archaeological sites in the SFMLRP are considered fire-sensitive, according to the Region 3 programmatic agreement (PA), Appendix J, Section 3 (U.S. Forest Service 2010b).

Known fire-sensitive site types in the Southwest Region include:

- Historic sites with standing, or downed wooden structure or other flammable features or artifacts
- Rock art sites (depending on rock art type, exposure, fuel type, and fuel loading)
- Cliff dwellings
- Prehistoric sites with flammable architecture elements and other flammable features or artifacts
- Prehistoric sites with exposed building stone or sot or porous materials such as volcanic tuff
- Culturally modified trees, including aspen art and peeled /scarred trees
- Certain traditional cultural properties (based on consultation with tribes)

Other project-specific fire-sensitive sites:

- Other sites, based on local field conditions and Forest-specific concerns
- Other sites, based on consultation with SHPO staff

- Other sites, based on consultation with fire management staff, fire behavior specialists or fire effects researchers.

Table 3.43. Summary of Known Heritage Sites in Project Area by Type

Site Type	Number	Percentage
Historic	51	55
Prehistoric Artifact Scatter	17	18
Rock Shelter	10	11
Shrine/Monument	7	8
Other	4	4
Lithic Procurement	3	3
Structure (Prehistoric)	1	1
Total	**93**	**100**

The U.S. Forest Service Southwestern Region (Region 3) has a PA with the Advisory Council on Historic Preservation (ACHP) and State Historic Preservation Office (SHPO) that stipulates the U.S. Forest Service's responsibilities for complying with the National Historic Preservation Act (NHPA) (U.S. Forest Service 2010b). The Southwestern Region has developed a standard consultation protocol for large-scale hazardous fuels reduction, vegetation treatment, and habitat improvement projects: the Region 3 Programmatic Agreement Regarding Historic Property Protection and Responsibilities, as amended (U.S. Forest Service 2010b). By following the procedures of this protocol, the ACHP and the SHPOs have agreed that the U.S. Forest Service will satisfy legal requirements for the identification, evaluation, and treatment of historic properties. The SFNF complied with the protocol in lieu of standard consultation in the PA and the ACHP's regulations (36 CFR 800) with the submission of the Santa Fe Mountains Landscape Resiliency Project: Phase 1 Literature Review (Campbell and Comstock 2021). With this report and its submission, the SFNF expects to receive concurrence on site eligibility determinations, as well as for management recommendations and a finding of no adverse effect with given mitigations outlined for the Proposed Action.

3.11.2 Environmental Consequences

Methods and Assumptions Used for Analysis

The analysis area for heritage resources is the SFMLRP area for consideration of impacts of Proposed Actions to cultural resources. For impacts to heritage resources, the definition of a short-term impact is 1 to 5 years because immediate fire effects are expressed during this time period, such as the response of herbaceous plants and shrubs. A long-term impact is defined as occurring 6 years post-treatment and beyond because the structure and composition of vegetation recover from fire effects by this time, but soil and other erosion effects are often longer lasting.

The following discussion and recommendations resulted from a review of the various descriptions of the alternatives and an assessment of the potential impacts each could have to cultural resources within the analysis area. Cultural resource data from previously recorded sites within the project area are summarized in the *Santa Fe Mountains Landscape Resiliency Project: Phase 1 Literature Review* (Campbell and Comstock 2021). These data were collected using a records search of the New Mexico Cultural Resources Information System, the General Land Office records provided by the Bureau of Land Management, and the SFNF heritage files and digital databases. These background searches were completed to determine the amount of previous survey in the analysis area and the location and density of previously identified archaeological sites and historic properties. Site records were reviewed for status of National Register of Historic Places (NRHP) eligibility, current condition, previous disturbance, and fire sensitivity.

Under the regulations, an adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a cultural resource that qualify the property for inclusion in the National Register. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance, or be cumulative. Specific examples of adverse effects cited in statute 36 CFR 800.5 include:

- Physical destruction of or damage to all or part of the property.
- Removal of the property from its historic location.
- Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance.
- Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features.

Impacts to cultural resources, especially archeological sites, can be generally defined as anything that results in the removal of, displacement of, or damage to artifacts, features, and/or stratigraphic deposits of cultural material.

Alternative 1: No Action Alternative

Under the No Action Alternative, the current conditions of the SFMLRP analysis area would remain the same in the immediate future. There would not be any direct project impacts to archaeological resources, and sites would continue to be exposed to the customary and natural threats, such as weathering, erosion, and high-intensity wildfire. Indirect effects of the No Action Alternative include an expected continuing buildup of fuels, which would lead to an increased risk of high-intensity wildfire behavior. The increased risk of wildfires could lead to increased damage to fire-sensitive archaeological sites exposed to the sustained, intense heat from wildfires (Lentz et al. 1996).

Under the No Action Alternative, the landscape would continue to depart from desired conditions for the Forest. In this vein, cultural resources would become less resilient to the effects of wildfire, climate change, and other environmental processes. These resources would therefore remain vulnerable to high-intensity wildfire. Furthermore, in the long term, vegetation buildup would increase the severity of wildfire, risking higher degrees of damage to or consumption of archaeological resources. This scenario does not meet Forest objectives for healthy cultural resources, although there is zero risk of short-term impacts to sites from project activities. On the whole, this alternative is a net detriment to the health and resiliency of cultural resources (U.S. Forest Service 2021j).

Alternative 2: Proposed Action

The removal of trees would reduce long-term fuel continuity, fuel loading, and fire hazard. This type of treatment would benefit cultural resources within the project area by decreasing the potential for adverse effects caused from high-intensity, high-severity wildfires. If the design features (Heritage-1 through Heritage-26) presented in Appendix C are followed, the proposed treatments should have no significant direct or indirect effects on eligible, listed, and unevaluated cultural properties.

VEGETATION THINNING TREATMENTS

Mechanical and manual vegetation thinning treatments could impact undiscovered cultural artifacts due to disturbance of surface vegetation and soils, potential exposure of buried artifacts, or impacts of compaction due to tracks from heavy machinery. Manual vegetation thinning would be less likely to adversely affect cultural resources because chainsaw operators could avoid flagged areas more easily than mechanical equipment. Mechanical methods would be carefully selected and would be avoided in areas that may be vulnerable to disturbance (design features Heritage-13 through Heritage-16 in Appendix C). Mechanical methods would be beneficial in some areas where dense vegetation threatens the long-term persistence of cultural resources due to the potential for wildfire or the degrading nature of vegetation on the integrity of the artifact as a result of root growth and surface vegetation growth and decay. It is anticipated that there would be no adverse effects on archaeological resources as a result of implementing heritage design features (Heritage-13 through Heritage-16 in Appendix C). Rather, these resources would benefit from vegetation treatments due to reduction of high severity wildfire risk (U.S. Forest Service 2021j).

USE OF PRESCRIBED FIRE

The direct impacts of fire on prehistoric archaeological sites include but are not limited to the refiring of ceramic material; melting of obsidian artifacts; burning, smudging, and spalling of architecture; and the accelerated erosion of site features caused by hydrophobic soils (Lentz et al. 1996; Ryan et al. 2012). This erosion could denude the ground surface, disturbing intact archaeological deposits and exposing cultural materials. Historic sites that are either combustible or include combustible cultural material are the most vulnerable to fire because archaeological material can be partially or completely consumed during a fire event. Other historic artifacts such as metal and glass artifact scatters have the potential for discoloration, charring, or melting (Ryan et al. 2012).

Although unpredictable spread of prescribed fires have the potential to damage fire sensitive cultural material, proper mitigation and consultation between the fire management staff and U.S. Forest Service archaeologists would decrease or eliminate the likelihood of these negative direct effects on cultural resources (Heritage-16 through Heritage 22). Removing heavy fuels from the cultural resource sites is the most effective way to protect non fire-sensitive sites from significant fire effects (Elliott 1999; Lentz et al. 1996; Lissoway and Propper 1990) (Heritage-21). Any type of fire (prescribed or wildfire) may burn more intensely in areas that were not mechanically treated.

The indirect impacts of fire on archaeological sites often have more lasting effects than the direct impacts. Fire suppression and/or heavy machinery associated with fire suppression has the potential to damage sites in the analysis area. In addition, increased site visibility caused by removal of vegetation can substantially increase inadvertent or advertent vandalism or disturbance to sites, potentially including those actively visited by tribes. The biggest indirect impact of prescribed fire to site condition, however, is due to increased erosion from loss of ground cover (Oster et al. 2012). Although a catastrophic fire would have more impact on cultural material than a broadcast burn, prescribed burning would also increase erosion on archaeological sites throughout the analysis area (U.S. Forest Service 2021j).

If fire is implemented in a low severity context, fire-induced erosion would be minimized and would result in soil erosion to a far lesser degree than would a high-severity wildfire resulting from the No Action Alternative. Thus, the firing conditions resulting from the Proposed Action are preferable to those resulting from the No Action Alternative; and with mitigations in place (Heritage-16 through Heritage-21), the indirect impact to cultural resources should remain insignificant. These mitigations prior to burning (Heritage-16 through Heritage-22) would be paired with post-burn monitoring (Heritage-20) and can be addressed using erosion control efforts such as slash left in place during site treatments.
The potential effects from other prescribed fire activities such as constructing fireline, digging out

smoldering roots and stumps, and cutting trees or snags, could damage cultural resources and would not be allowed within site boundaries. It is therefore anticipated that no adverse effects on archaeological resources would result from the Proposed Action (U.S. Forest Service 2021j).

RIPARIAN RESTORATION TREATMENTS

In areas where riparian vegetation is in poor condition, or is being encroached with conifers; vegetation thinning, prescribed burning, and native species plantings would occur. All of these project activities have the potential to adversely affect cultural resources and would therefore only be allowed within known archaeological site boundaries if sites are flagged and all other design features are followed (Heritage-1 through Heritage-26 in Appendix C). As the proposed restoration activities would result in healthier and more stable waterways, cultural resources occurring in riparian contexts and excluded from direct effects of implementation would benefit from the Proposed Action. Such scenarios as reduced flooding following high severity wildfire within the watersheds and therefore reduced inundations of cultural resources in these locations would occur (U.S. Forest Service 2021j).

ROAD CLOSURE

Closure to the public of 1.5 miles of FR79W would occur as part of the Proposed Action alternative. Access to this area to private in-holders would continue. With this road closure, either incidental or intentional vandalism or looting to cultural resources accessed via this road would be greatly diminished. Although this 1.5 miles of road closure is a very small length in the context of the forest road system within the analysis area, cultural resources in this area would benefit from this proposed activity. Implementation of mitigation measures Heritage-23 through Heritage-26 would minimize impacts from forest road closures (see Appendix C).

Cumulative Effects

The cumulative effects on cultural resources should take into account all surface-altering actions that have occurred or are likely to occur within the SFMLRP Area. Previous and current U.S. Forest Service management activities, public resource procurement and recreational use, and natural processes have impacted cultural resources. However, through the use of standard mitigation measures (Heritage-1 through Heritage-26), these impacts have substantially diminished. Within the Santa Fe National Forest, there are other planned or reasonably foreseeable activities that may affect cultural resources. These projects include routine road and trail maintenance, aquatic restoration, road and trail decommissioning, invasive species removal, and additional vegetation thinning and prescribed fire projects. Although many of these activities would coincide with the Proposed Action, if proper mitigation measures (Heritage-1 through Heritage-26) are followed for avoiding sites during mechanical treatments, and if sites sensitive to erosion and fire are monitored before and following the prescribed burns, it is not anticipated that the cumulative effects would have a significant impact on cultural resources (U.S. Forest Service 2021j).

Present and reasonably foreseeable future projects (see Table 3.1) within the analysis area would either comply with the Region 3 PA or undergo individual evaluation under Section 106 of the NHPA. Through this process, impacts to cultural resources would either be avoided or mitigated. Unanticipated discoveries during proposed activities would result in work ceasing in the area and notification of the Forest Archaeologist.

When considering past, present, and foreseeable future actions, the Proposed Action has the potential to increase the amount of ground-disturbing activities and prescribed fire across the landscape. Design features have been or would be implemented to keep ground-disturbing activities out of archaeological site boundaries (Heritage-1 and Heritage-2). Fuels reduction treatments have been or would be implemented to minimize fire effects on archaeological sites and historic resources during prescribed fires. Because of this, the potential cumulative effects on cultural resources are not considered to be adverse.

Increasing the scale of restoration treatments instead of conducting small “postage stamp” restoration projects, would reduce fuels at the landscape scale. Reducing fuels would provide long-term protection for the entire landscape and all of the archaeological sites within it, from disturbances such as wildfire. Cumulatively, all of the various forest management projects in and adjacent to the project area would measurably improve long-term protection of cultural resources. They would have a low potential for adverse effects on archaeological sites in the project area.

Summary

The analysis area contains 93 previously documented archaeological sites: 51 sites considered eligible, 26 undetermined until further testing, and 15 determined not eligible. One site, Glorieta Baldy Lookout, has been listed on the National Register of Historic Places. All listed, eligible, and unevaluated sites would be flagged and avoided by mechanical treatments. Hand-thinning and prescribed burning may occur within site boundaries provided the mitigation measures specified in the specialist report (U.S. Forest Service 2021j) are followed. Sites with combustible material would be protected during prescribed fire. Eligible, listed, and unevaluated sites would be monitored after the proposed treatments to assess whether the sites were adequately avoided and the extent to which the treatments had indirect effects (i.e., damage from increased erosion) on the sites. This project meets the standards and guidelines set forth in U.S. Forest Service Manual 2360, Region 3 Supplement 2300-91-1 and is in compliance with Section 106 of the NHPA, as amended. Given the nature of potential effects and the utilization of standard mitigation measures, the Proposed Action would have no adverse effect on cultural resources (U.S. Forest Service 2021j).

3.12 Tribal and Traditional Uses

The focus of this section is to analyze the following question:

How would the project treatments impact traditional cultural uses within the project area?

3.12.1 Affected Environment

The SFNF recognizes the importance of the deep connections and associations Native American groups and other traditional communities have to the project area. National Forest Lands contain ancestral lands, significant ancestral sites, sacred areas, and resource collection areas significant to Pueblo communities. Many of these communities are adjacent to or surrounded by National Forest Lands. The SFNF Land Management Plan in its Management Direction specifically includes traditional uses of Forest lands by the people of Northern New Mexico. There are deep and historic ties between nearby populations and the Santa Fe NF. As a defining element of northern New Mexico’s cultural context, the lands of the forest have continuously provided economic, social, and religious value to traditional communities (U.S. Forest Service 2022b).

Additionally, many traditional communities adjacent to and within the Greater Santa Fe Mountains Fireshed have strong ties to the land primarily as a resource base. The traditional knowledge and use of the project area stems from the lands association with the Spanish land grant system as “common lands” or *ejidos* of the land grants. The “common lands” provided the land grant communities access to grazing land, stone resources, wood, game, medical plants, and other Forest products. These connections can be seen in social and ceremonial use of specific land forms by these communities. These same lands still provide firewood and other plant resources for these traditional communities.

An ethnographic assessment was conducted for the Fireshed, involving a qualitative study of the viewpoints of 12 Rio Grande Pueblos and the Jicarilla Apache Tribe, as well as members of traditional communities represented by neighboring land grants (Brown et al. 2018). The ethnographic assessment found that the area is very important to the tribes, and they have a strong interest in how it is managed by the U.S. Forest Service. The following paragraphs are a summary of the study cited as Brown et al. (2018).

Tribes all expressed concern with the health and ongoing proper management of the project area, which is considered their ancestral lands and contains significant areas for the continuation of their ceremonial, traditional, and subsistence practices. Bodies of water and high peaks are particularly important, but spatial data for specific landscape features or resource types were not shared with ethnographers. The health of the waterways within the project area is also very important to the tribes. Several tribes stressed the variability in location of wild resources from season to season and thus the difficulty in pinpointing certain important resource locations. Sensitivity and mistrust were also reasons given for not divulging sacred site locations (Brown et al. 2018).

Shrines are currently maintained and routinely visited; and ceremonies are performed by tribal members at other nearby, undisclosed locations within the project area. Many tribes, namely the Pueblos of Tesuque, Cochiti, San Felipe, and Santa Clara, expressed great interest in being intimately involved in planning and implementation of forest restoration efforts. Environmental departments of the tribes are currently conducting such fieldwork on their own lands, and they would like the opportunity to do the same in areas sacred to them on the Forest (Brown et al. 2018).

Use of the Fireshed by members of traditional communities today mainly centers on grazing with limited woodcutting, plant gathering, grazing, hunting, and fishing; although they shared that current use levels are lower than in the past. Traditional communities also recognized the importance of fuel reduction to reduce the risk of high-intensity wildfire which threaten their communities. Traditional communities were concerned, as were the tribes, as to how roadless areas would be treated, and that thinning would invite additional bike and all-terrain vehicle traffic in that access routes used by mechanical equipment as well as firelines would in turn become used by recreationists if visible to them. Additionally, there was concern that their fences used for graze management would be burned during prescribed fire activities (Brown et al. 2018).

3.12.2 Environmental Consequences

Methods and Assumptions Used for Analysis

Archaeological analysis was completed for the SFMLRP via a Phase 1 literature search and review of existing adequate archaeological survey and known archaeological sites (Campbell and Comstock 2021). This was followed by an effects analysis, summarized in Section 3.11 of this EA. The Santa Fe Fireshed ethnographic assessment (Brown et al. 2018) was also reviewed and used to inform the analysis of potential effects on traditional uses within the SFMLRP area.

The focus of this specialist report is to identify and disclose the potential impacts of the SFMLRP alternatives on the traditional use of the area, including the collection of traditional cultural material and use of sacred sites. Traditional uses can also include the visitation of archaeological sites; thus, this analysis also addresses potential impacts to archaeological resources from the SFMLRP alternatives. Although specific site information was not provided by the pueblos for traditional uses or active shrines, it may be assumed that the resource type fits the category of natural vegetative resources for collection, such as a stand of trees or other traditionally used plants, or other natural resources such as bedrock or peaks or constructed stone features such as shrines.

Alternative 1: No Action Alternative

Under the No Action Alternative, the forest restoration treatments would not be implemented. There would, therefore, be no direct effects of mechanical treatment or of prescribed, low-intensity fire. Without the landscape-scale treatments, TCPs, sacred sites, and traditional use areas within the project area would continue to be at risk of experiencing an uncharacteristically severe wildfire. In addition to this continued risk, an indirect long-term effect would be the continued accumulation of fuel in culturally sensitive areas, including fire-sensitive traditionally used resources.

Under the No Action Alternative, many valuable TCPs, sacred sites, and traditional use areas would be at risk to damage or consumption by wildfire. This would cause loss of important historic information and sacred sites and could impact tribal ceremonial practices. If the entire project area was consumed in a severe wildfire, 93 known archaeological sites and many more unknown and undocumented ones could be damaged. These are sites that would have been treated under the Proposed Action alternative and made more resilient to wildfires. Ultimately, the landscape would not be moved toward this desired condition for vegetation communities defined in EA Chapter 1. In this scenario, the ability of tribes to gather traditional resources would be greatly diminished or eliminated entirely if these were damaged by high-severity fire. Additionally, the ability of traditional communities to benefit from forest products would be reduced or eliminated (U.S. Forest Service 2021c).

Alternative 2: Proposed Action

The general feeling among the tribes interviewed for Santa Fe Fireshed ethnographic assessment (Brown et al. 2018) is that the goals behind proposed forest restoration treatments, such as the treatments proposed under SFMLRP, are all ones they support as they aim to promote ecosystem health and prevent disastrous fires. From the perspective that the entire Fireshed area and beyond is sacred, the proposed treatments would ultimately result in very positive ecological effects on the area if implemented sensitively and correctly. Furthermore, the proposed forest restoration treatments would prevent the potentially very negative effects of a catastrophic fire, especially one that affects the streams originating in the Fireshed.

Tribes and traditional communities alike are more concerned over how the proposed forest restoration treatments are completed rather than whether it is done. The foremost apprehension is the possibility that the U.S. Forest Service or its contractors would employ heavy machinery to accomplish fuels reduction, vegetation thinning, or other treatments, resulting in ground disturbance, damage to heritage resources, damage to understory vegetation, and increased erosion. Given that specific resource locations were not identified by the ethnographic assessment, the analysis of SFMLRP Proposed Action is necessarily general and focuses more on the processes of planning, extensive consultation, mitigation of potential adverse effects (Heritage-1 through Heritage-26 in Appendix C), and implementation rather the form and location of these efforts.

TCPs, sacred sites, and gathering locations would be directly affected by the proposed forest restoration treatments in a similar way as described in the SFMLRP cultural resources specialist report (U.S. Forest Service 2021j). Traditional gathering locations which include organic materials (wood, herbs, flowers, etc.) are at risk of being directly impacted by vegetation removal during vegetation thinning treatments due to the use of heavy equipment, human presence, and vehicles in areas where the organic materials occur. In addition, access to the TCPs, sacred sites, or gathering locations could be limited during treatment implementation because people accessing the traditional use resources might be disturbed by the treatment activities.

Vegetation thinning followed by prescribed fire could result in increased soil erosion and run-off as an indirect effect of the Proposed Action. A direct effect of the use of prescribed fire could also include partial or complete consumption of a traditional use area by fire. Sacred sites containing stone features could be impacted by fire in the form of sooting, cracking, or spalling, impacting the character of these sites. However, the proposed fuel reduction and low to moderate-intensity prescribed fires should not sterilize the soil or create hydrophobic soils in the way that high-heat and high latency period wildfires tend to do. These low-intensity prescribed fires would leave some vegetation in place. Therefore, the indirect effect of this Proposed Action is less than if resources were to continue with current fuel loads and high-severity fire risk.

Riparian restoration efforts pose a short-term impact to ceremonial practitioners as project implementation may prevent access to sacred sites. The long-term benefit of these restoration activities include improved riparian health; an increase in traditional, native plant communities; improved stability of water courses; and an increase in overall watershed health. This scenario would provide an overall benefit to traditional use of the Fireshed.

The closure of FR79W to the public would reduce recreation traffic on approximately 1.5 miles of road, reducing the impact of inadvertent and intentional looting to potential traditional resources in this location. The impact of this closure in both the short term and long term is anticipated to be minimal in the context of the overall Forest road system.

Consulting with the tribes before project implementation would help to identify sacred sites and traditional use areas to avoid or mitigate these possible effects. Coordination with tribal governments would allow for resolution of these potential effects, and so the potential effects are not considered in this analysis to be adverse. For example, if informed by consultation, the use of vegetative screening and considerate scheduling of project treatments could reduce adverse impacts. The array of mitigations measures (Heritage-1 through Heritage-26 in Appendix C) could extend beyond those provided for the protection of archaeological resources in Appendix J Section II of the Region 3 PA (U.S. Forest Service 2010b).

Cumulative Effects

When considering present, and foreseeable future actions (as described in Table 3.1), the SFMLRP Proposed Action has the potential to increase the amount of ground-disturbing activities and prescribed fire across the landscape. All of these undertakings that have the potential to affect cultural resources, sacred sites, and traditional use areas would be analyzed as required under Section 106 of the NHPA. Mitigation measures (Heritage-1 through Heritage-26 in Appendix C) have been or would be implemented to keep ground-disturbing activities out of archaeological site boundaries and other culturally sensitive sites. Fuels reduction treatments would be implemented to minimize fire effects on archaeological sites and traditional cultural properties during prescribed fires. Because of this, the potential cumulative effects on cultural resources are not considered to be adverse.

Increasing the scale of restoration treatments instead of conducting small “postage stamp” restoration projects, would reduce fuels at the landscape scale. Reducing fuels would provide long-term protection for the entire landscape and all of the archaeological sites and traditional cultural properties within it from disturbances such as wildfire. Cumulatively, all of the various forest management projects in and adjacent to the project area would measurably improve long-term protection of cultural resources, TCPs, sacred sites, and gathering locations. They would therefore have a low potential for adverse effects on heritage resources in the project area and insignificant cumulative effects.

Summary

Both initial project scoping for the project area and the ethnographic assessment conducted in the Fireshed reveal that tribes and traditional communities affiliated with the SFMLRP area support U.S. Forest Service ambitions to reduce the risk of catastrophic wildfire and improve forest health. Concern surrounds rather how these objectives are met, with reservations about the impact of heavy equipment and opening up the watershed to heavier visitation by recreationists. Watershed health is an overarching concern of both tribes and traditional communities who still depend on these headwaters; thus, goals of these communities and of the Forest to improve stream health are aligned. That tribes are not willing to share location specific information regarding resources important to them necessitates additional consultation efforts and much involving of the tribes in details of project planning and implementation moving forward. Strengthening these partnerships via collaboration and facilitating active participation in project development is a goal of the forest plan as well as of federal guidance concerning tribal relationships.

The Proposed Action alternative would achieve the desired condition for traditional cultural uses. The No Action Alternative further decreases the resiliency of the traditional use areas of the SFMLRP and puts these irreplaceable cultural and natural resources at greater risk of destruction. Traditional cultural uses can be appropriately considered and effectively protected via continued consultation and collaboration with tribes and traditional rural communities and the use of standard best management practices, mitigation measures, and design features for known sensitive sites. Given the nature of potential effects and the application of these measures, the specialist report finds that the Proposed Action would likely have no adverse effect on traditional cultural uses (U.S. Forest Service 2021c).

3.13 Range Resources

The focus of this section is to analyze the following question:

How would grazing impact the effectiveness of the proposed treatments?

To address this issue, it is important to note that the forest ecosystems with the SFMLRP area have evolved with fire and natural fire return intervals that maintained a more resilient landscape. Past forest management practices and fire suppression have allowed for the accumulation of fuel loads that increase the risk of high-intensity, catastrophic wildfires. Livestock grazing is a land use that has been shown to decrease fine fuel loads which carry fire. Grazing animals can modify wildfire fuels, particularly smaller-sized live fuels and 1- and 10-hour dead fuels, through consumption and trampling. These fuels influence an important part of fire behavior by providing flammable material that can serve as ladder fuel that enables a fire to extend from the ground upward into the brush and tree canopy (Nader et al. 2007). Livestock grazing will have the most effect in areas where grass is the primary carrier of fire. Livestock grazing along with the proposed treatments can manipulate these fuels to reduce the chances of high fire intensity within the project area. Livestock grazing effects in combination with the proposed treatments is anticipated to have an advantageous effect.

The remainder of this section focuses on the following question:

How would the proposed project treatments impact livestock grazing within the project area?

3.13.1 Affected Environment

Livestock grazing is important to the local economy and is directly tied to the history and strongly rooted culture that has shaped the present-day area. There are several small predominantly Hispanic villages near the project area. The residents retain their traditional values and depend on the use of natural resources, including livestock grazing and the use of forest products. Raising livestock contributes to a sense of identity, prestige within the community, pride of lifestyle, and a feeling of self-sufficiency. These create a strong sense of community (Raish and McSweeny 2003, 2012).

Livestock grazing contributes to the livelihood of permittees and the economy of local communities and counties. For most permittees, livestock grazing is generally not a commercial venture. Most of the permittees have other jobs and do not make their sole living from livestock production, although for some, a substantial portion of their income is derived from livestock. The permittees typically own small ranches, and federal grazing permits are integral to their overall operations.

The project area overlaps three active grazing allotments: Aspen Mountain, Glorieta, and Macho. The SFMLRP also overlaps two permanently closed grazing allotments: Gabaldon and Santa Fe Watershed (Figure 3.23). The Aspen Mountain allotment consists of 16,768 acres; recent inspections of the allotment indicate that range resources are in balance with permitted use. Within the Glorieta allotment, a majority of the capable range acres are considered in satisfactory range management status; very few acres are considered to be in unsatisfactory range management status. The Macho allotment, which comprises 821 acres within the project area, is considered to be in satisfactory range condition. The remaining two grazing allotments, Gabaldon and Santa Fe Watershed, are permanently closed; no livestock grazing is permitted (Table 3.44). Range improvements within the project area include 33.5 miles of fence and one cattleguard.

Adaptive management is used to adjust range resource conditions to achieve and maintain range management standards. In response to changing resource conditions, the number of authorized livestock, season of use, and levels of livestock use (expressed in Animal Unit Months [AUM]) can vary from year to year.

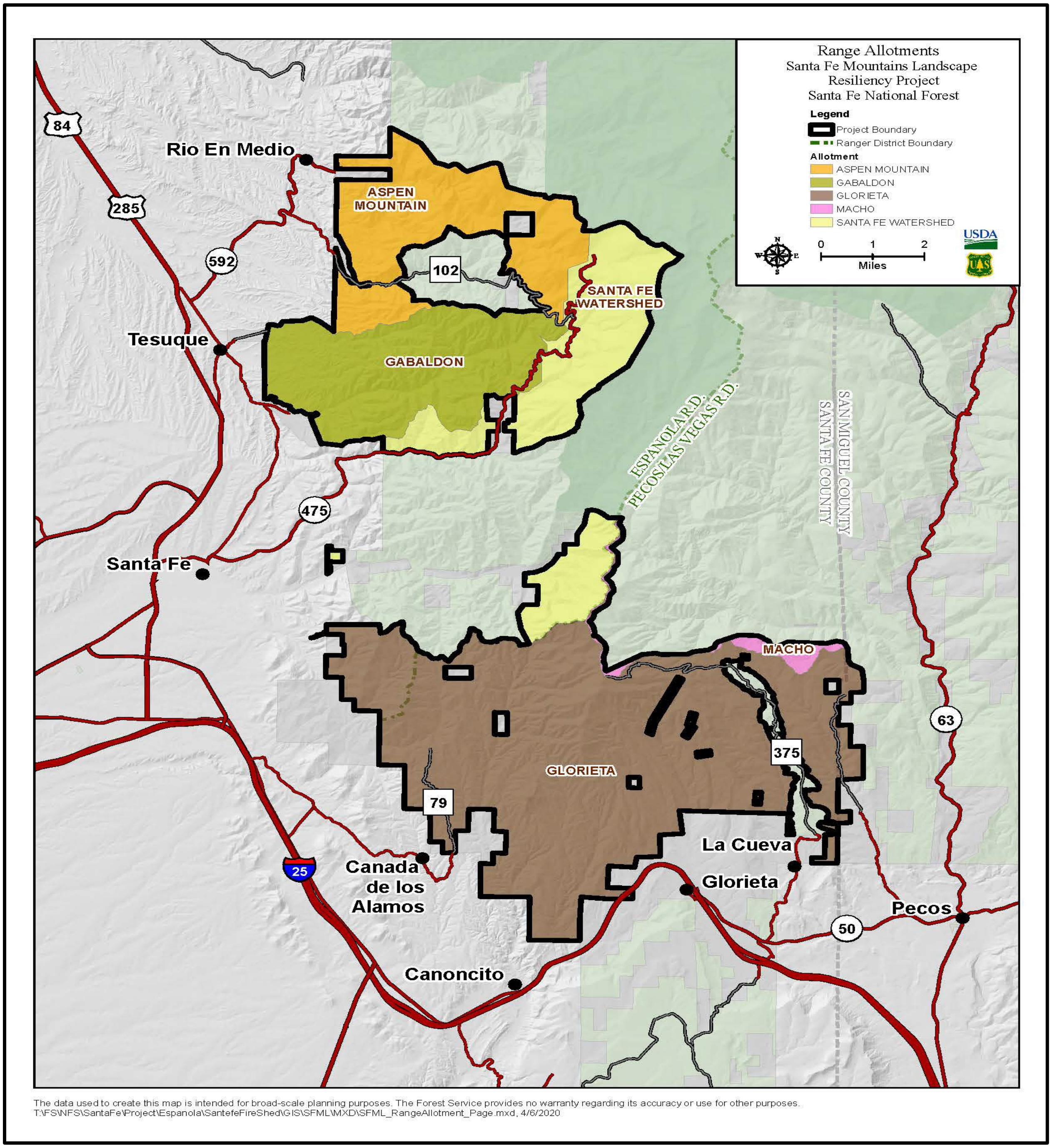


Figure 3.23. Grazing allotments within the project area.

Table 3.44. Grazing Allotments and Acreage within the Project Area

Allotment Name	Allotment Status	Total Size of Allotment (acres)	Portion of Allotment in Project Area (acres)	Portion of Allotment in Project Area (%)	Number of Permits	Number of Permitted Livestock	Animal Unit Months
Aspen Mountain	Active	16,768	7,529	45	5	49 Cow/Calf 4 Bulls	323 15
Gabaldon	Closed	8,120	8,092	100	0	0	0
Glorieta	Active	30,466	26,346	86	1	16 Cow/Calf	222
Macho	Active	36,415	821	2	1	16 Cow/Calf	106
Santa Fe Watershed	Closed	23,012	7,721	34	0	0	0
Total		**114,781**	**50,509**		**7**	**81 Cow/Calf 4 Bulls**	**663**

3.13.2 Environmental Consequences

Methods and Assumptions Used for Analysis

The SFMLRP Proposed Action was compared to U.S. Forest Service GIS grazing allotments and ERU data to estimate impact calculations for this section. U.S. Forest Service staff knowledge of the area was also used to inform the impacts analysis disclosed below. Private and tribal lands were not analyzed (U.S. Forest Service 2021k).

The effects of forest thinning and prescribed burning to livestock grazing is analyzed in this report. Table 3.45 shows resource indicators and measures used to analyze the impacts of the proposed project to range resources.

Table 3.45. Resource Condition Indicator and Measure for Assessing Effects on Livestock Grazing

Issue	Indicator or Measure
Changes to the livestock grazing conditions and allotment management	Quantification of acres of proposed forest restoration treatments within active livestock grazing allotments. Qualitative discussion of changes to range capability and effects on herbaceous vegetation (abundance and diversity).

For range resources, the definition of a short-term impact is 1 to 5 years immediate treatment effects are expressed during this time period, such as the response of herbaceous plants and shrubs. The definition of a long-term impact is 6 years and beyond because the structure and composition of vegetation recover from fire effects by this time.

The spatial extent of analysis is the three active grazing allotments (Aspen Mountain, Glorieta, and Macho) that occur within the SFMLRP boundary as shown in Figure 3.23.

Alternative 1: No Action Alternative

Under the No Action Alternative, permitted livestock numbers would stay the same. Forest ecosystem conditions would continue to decline, there would be no vegetation treatments to modify stand structure in order to improve forest resiliency in the project area. Vegetation thinning using mechanical and manual treatments would not occur and the overgrown conifer forests with unnaturally high densities of small size-class trees would remain. The overgrown forests would continue to adversely impact rangeland health by suppressing forage availability, including native grasses, forbs, and shrubs for livestock. As shade-tolerant species become dominant and alter the species composition of the forest, the grasses, forb, and shrub matrix of the forest would decline. The canopy would continue to grow denser and the resources needed for the understory, including water and sunlight, could become limiting factors leading to a decrease in the amount of grasses, forbs, and shrubs in the understory. The amount of available forage and plant diversity would decrease. In the long term, the stand structure would become more uniform, promoting a less-diverse vegetative community with reduced growth of rangeland resources, particularly of native grasses, forbs, and shrubs. These effects accompanying poor forest health would adversely affect rangeland resources.

Under the No Action Alternative, the use of prescribed fire would not occur, the overgrown stand density would remain, and the risk of high severity wildfire would persist. If historic fire-adapted ecosystems are not maintained and/or restored, availability of grasses, forbs, and shrubs for livestock grazing would decline. The overgrown understory of small size-class trees would continue to increase, which would elevate the risk of wildfire within grazing allotments over the long term.

Within the SFMLRP area, rangeland capability—the potential of an area of land to produce resources, supply goods and services, and allow resource uses under an assumed set of management practices and at a given level of management intensity, and the ability of grazing livestock to move freely within an allotment—is declining because of tree encroachment and would be expected to continue to decline. Under the No Action Alternative, no forest restoration treatments would occur, herbaceous vegetation density and diversity would continue to decline, and rangeland capability and forage production would not improve.

Alternative 2: Proposed Action

Implementing the Proposed Action would have both adverse and beneficial short-term impacts to rangeland resources. Impacts from each restoration method are discussed below. Overall, the Macho and Aspen Mountain allotments would have minimal impacts from the Proposed Action as less than half of the acreage associated with these allotments overlaps the project areas and therefore those portions outside the project area would not be subject to forest treatments. A larger portion of the Glorieta allotment would be subject to proposed forest treatments, if the conditions-based management approach identifies the need for treatments within the allotment. Since the Glorieta allotment has only 16 cow/calf pairs grazing over 30,000 acres, there would be minimal adverse impacts to the allotment over the short term because up to 750 acres annually would be treated with vegetation thinning and up to 4,000 acres annually would be treated with prescribed fire throughout the entire project area. During proposed treatments, the permitted livestock would be able to graze in other areas not currently scheduled for treated.

Range infrastructure, including fences and the one cattleguard within the project area, would likely not be affected by the Proposed Action because the U.S. Forest Service would coordinate proposed treatment activities district range staff to coordinate pasture use (Design Feature Range-2 in Appendix C). In addition, the forest restoration treatments would reduce the risk of wildfire in some parts of the forest, which would help protect range improvements from wildfire events.

Design features Range-1 through Range-13 would help minimize, avoid, or mitigate adverse short-term effects on rangeland resources (see Appendix C). Under the Proposed Action, the number of permitted AUMs would remain the same on Term Grazing Permits, however adaptive management would continue to be used to adjust current resource conditions with livestock numbers. The number of authorized livestock, season of use, and levels of livestock use can vary from year to year based on resource conditions.

VEGETATION THINNING TREATMENTS

Approximately 34,694 acres of active grazing allotments would be subject to vegetation thinning treatments within the SFMLRP area over the life of the project, with an estimate of no more than 750 acres of vegetation thinning treatments annually. Mechanical treatments and stand improvement thinning would have some minor short-term impacts (1–6 years) on livestock grazing, grazing management, and the permittees. These include the loss of available forage or use of pastures and damage to range infrastructure (fences, water tank, or cattleguards). These impacts could result from the activity of vegetation thinning equipment and other project-related vehicle traffic (U.S. Forest Service 2021k).

Mechanical treatments have been implemented in the general area in the past with few impacts on livestock grazing, allotment management, and permittees. For this project, damage to range infrastructure would be avoided to the extent possible. Per design feature Range-4, if there is damage to infrastructure from treatments, it will be restored before the project is completed (see Appendix C). This would reduce impacts on livestock grazing before and during these treatments. Even so, it may be necessary in some instances to limit or delay grazing in areas where mechanical thinning treatments are actively occurring. Manual thinning has a minimal if any effect on livestock grazing due to low disturbance in areas that are being treated.

Over the long term, reducing tree density with vegetation thinning treatments would increase the diversity and abundance of understory plants—grasses, forbs, and shrubs. Removing trees opens up the canopy and allows more light and precipitation to reach the forest floor and reduces competition between plants for soil moisture and nutrients. These conditions improve growing conditions for understory plants in dry forest types including pinyon-juniper (Bates et al. 2000; Brockway et al. 2002), ponderosa pine (Covington et al. 1997; Griffis et al. 2001), and mixed conifer (Collins et al. 2007). The combination of vegetation thinning treatments followed by prescribed fire often has an additive effect—the increase in understory vegetation is greater after the two treatments than after either one by itself (Griffis et al. 2001; Laughlin et al. 2008).

Long-term beneficial effects on rangeland resources could result from debris left over from vegetation thinning treatments, which could enhance soil productivity and resilience to invasive nonnative species. The remaining slash debris contains significant amounts of carbon and nitrogen which regenerates the soil fertility leading to more plant processes and ultimately plant diversity. The debris also acts as a natural mulch which increases soil water availability. Both processes coupled together work to suppress the introduction of nonnative species and enhance native vegetation communities (Kirkland 2012). Suppressing nonnative species and increasing soil productivity from debris would create long-term beneficial impacts to rangeland resources, including more forage availability for livestock.

The pinyon-juniper vegetation types would also have an increase in range capability and forage production. Vegetation thinning treatments would be done at different intensities- more trees would be removed in some areas than in others- to achieve specific management objectives. Because of this, the increase in herbaceous vegetation would vary across the treated areas. It may also take longer to occur in areas that are treated less intensely (fewer trees are removed).

Vegetation thinning treatments would increase range conditions and capability, since livestock could use areas that were previously inaccessible or had limited forage availability. Mechanical treatments and manual thinning, with or without prescribed fire, would also reduce fuel loads and lower the potential for an uncharacteristically severe wildfire that could cause significant damage to rangeland resources.

The long-term effects of mechanical and manual treatments outweigh the undesirable short-term effects. It is expected that over a 10-year period, the increase in forage production from these treatments would improve allotment conditions and livestock distribution, decrease utilization rates and allow for a more flexible grazing management scheme. These benefits would allow for a sustainable range program through drought years, and for low-intensity ground fires to occur on the landscape (U.S. Forest Service 2021k).

USE OF PRESCRIBED FIRE

The use of prescribed fire would result in adverse short-term effects (1–6 years) on vegetation, livestock grazing, allotment management, and individual permittees. Approximately 33,000 acres of active grazing allotments would be subject to prescribed fire treatments within the SFMLRP area over the life of the project, with an estimate of no more than 4,000 acres treated by prescribed fire annually. In some instances, small sections of a prescribed burn units or burn piles may burn too hot, thereby scorching the root crown and killing plants entirely. Creating areas of bare ground could lead to an introduction or propagation of nonnative invasive species (Zouhar et al. 2008). After a prescribed fire is completed, there would be a cessation of grazing (rest period in affected pastures) for at least one year (see design feature Range-13 in Appendix C). This rest period is needed to let the soil stabilize and for grasses and forbs to reestablish themselves and grow. Perennial grasses which lose their leaves in the first growing season following a fire (e.g., leaves consumed through grazing) produce less forage, do not grow as well, and have higher mortality rates (Jirik and Bunting 1994; Bunting et al. 1998). During the rest period, permittees may be required to temporarily reduce their authorized livestock numbers, shorten the season of use, or do a combination of both to allow herbaceous vegetation to recover and regenerate. Permittees would be minimally affected economically. Livestock management changes may cause permittees to move livestock, lease other pastures, and purchase replacement livestock for their herds. With extensive coordination between permittees, rangeland and fire/fuels staff prior to a treatment, the potential for adverse economic effects on permittees would be reduced. In addition, allowing these permittees to use understocked allotments elsewhere and use of altered pasture rotations would reduce or eliminate adverse economic and logistical impacts to permittee operations.

These short-term impacts on grazing and permittees discussed above would be reduced when considering maintenance or re-entry burning as compared to first entry burning. During a maintenance burn, livestock can be moved around an allotment to take advantage of improved forage while another part of the allotment is undergoing a maintenance burn. Reentry burns would also burn with less intensity because the amount of fuel would be greatly reduced during the initial burn, thus allowing for more flexibility in adaptive management.

Prescribed fire could potentially have greater effects on an allotment if there is a drought in the year before the burn. The drought would slow reestablishment of native herbaceous vegetation. In this scenario, after resting the affected pastures for at least one year, reductions of authorized livestock numbers, season of use, or a combination of both could compound the effects on livestock grazing, allotment management, and the permittees in order to align livestock grazing numbers with resource conditions.

An increase in range capability and improved range conditions after using prescribed fire is expected. This means that more of the allotment can be used by grazing animals under proper management without long-term damage to the soil resource or plant communities. Under current conditions, livestock cannot access some areas because of the dense forest. Other areas have limited amounts of forage because there are too many trees. Prescribed fire would thin the forest and remove fuels. This would allow livestock to use areas that were inaccessible before burning.

Prescribed fire would increase the amount of herbaceous vegetation within the ponderosa pine and mixed conifer frequent fire forest types. There would also be an increase in species diversity, abundance, and distribution of herbaceous vegetation (Covington et al. 1997; Webster and Halpern 2010). Similar effects on herbaceous vegetation are likely to occur in other forest types, including aspen (USDA 1989) and pinyon-juniper (Covington et al. 1991). Over the long term, the increase in forage production from the proposed prescribed fire treatments would improve allotment conditions and allow for a more flexible grazing management scheme because livestock distribution would improve and livestock utilization rates in any one specific area would decrease, meaning the concentration of grazing livestock would disperse to other areas with available forage. Range capability is also expected to increase. These benefits would allow for a more sustainable range program through drought years, and for low-intensity, naturally occurring surface fires to occur on the landscape, further sustaining forage production (U.S. Forest Service 2021k).

RIPARIAN RESTORATION TREATMENTS

Riparian restoration treatments within an estimated 100-foot buffer of established waterways are proposed along approximately 4.5 miles and 370 acres of Arroyo Hondo and approximately 12.5 miles and 310 acres of Tesuque Creek to improve watershed conditions. Improved riparian conditions in these treatment areas would contribute to an upward trend in Rangeland Capability and condition by improving the potential for diverse vegetation properly functioning riparian areas. Use of prescribed fire and vegetation thinning in riparian restoration areas would have a short-term adverse effect on livestock grazing. Adaptive management would be utilized when these management action occur within riparian areas in the project area.

Fencing around riparian restoration treatment areas would be installed if needed to protect restored areas if it is determined that riparian vegetation regeneration is being hampered by browsing and grazing. This would adversely impact livestock utilization of riparian areas within the project area over the long term. By excluding livestock from riparian areas it can impede livestock use of water and forage resources within these areas. The Arroyo Hondo is a main water source for livestock on the Glorieta allotment and Tesuque Creek is the main water source for the Aspen Mountain allotment; if these areas are fenced off by SFMLRP efforts to protect riparian vegetation, livestock could move upstream or downstream to obtain water.

ROAD CLOSURE

There would be no impacts to the ability of livestock to graze within the SFMLRP area as a result of the 1.5-mile road closure along Forest Service Road 79W, however the management of livestock will be minimally affected by limiting permittees access to hurt or sick livestock and if livestock are trespassing on private lands. Administrative use of the road would mitigate the permittee from being affected by the road closure (U.S. Forest Service 2021k).

Cumulative Effects

See Table 3.1 for a list of present and reasonably foreseeable future actions considered for cumulative effects on range resources.

The area considered for the cumulative effects analysis is the active allotments within the SFMLRP area because this is where cumulative impacts would be evident within allotments. The cumulative effects analysis considered past, present, and reasonably foreseeable future non-project activities and their effects, in combination with the Proposed Action.

The Proposed Action is not predicted to result in any long-term adverse impacts on current livestock grazing permit holders.

The past uses in the cumulative effects analysis area have had a direct effect on range capability, as described in Affected Environment and Environmental Consequences sections. Past uses mostly comprise of vegetation management projects that improve forage conditions for livestock benefit, however some recreation and urban interface projects have minimally changed livestock movement and management over the years but not significantly. Historic proliferation of mining and ranching roads, the establishment of federal, state, county, and private lands, and community development have all contributed to the current range conditions in the cumulative effects analysis area.

Ongoing and planned activities such as the vegetation treatments throughout the Santa Fe National Forest are similar in nature to the Proposed Action (but much smaller in scale, compared with the SFMLRP 50,566 acres). The cumulative impact of the actions listed in Table 3.1 to range resource would be short term and adverse because disturbance associated with these projects could temporarily disturb grasses and forbs during implementation. Over the long term, range resources would benefit from these projects because the project would improve range capability through the analysis area (U.S. Forest Service 2021k).

Summary

The No Action Alternative would have the least benefit to rangeland resources and ecosystem resilience because only small-scale, fragmented projects would be implemented across the landscape. Herbaceous vegetation and available livestock forage would continue to decline in areas that are not treated. There would continue to be periodic reductions in authorized livestock numbers or season of use, or a combination of both due to localized treatments.

Under the Proposed Action, range condition is expected to improve over the long term as forage production and quality increases, utilization rates decrease, and distribution of livestock improves. The long-term benefits would outweigh the short-term effects and would ultimately improve the ecological sustainability of livestock grazing, and substantially increase ecosystem resilience to uncharacteristically severe wildfire and other disturbances. Effects would be short term and would not result in permanent changes to permitted livestock numbers or season of use (U.S. Forest Service 2021k).

3.14 Inventoried Roadless Areas

The focus of this section is to analyze the following question:

How would the proposed treatments impact the character of the inventoried roadless areas (IRAs) within the project area?

3.14.1 Affected Environment

IRAs provide relatively undisturbed habitats for wildlife and have ecosystem functions to provide for clean water, soil, and air; opportunities for dispersed outdoor recreation; and locations for study and research. The 2001 Roadless Area Conservation Rule, also referred to in this report at the 2001 Roadless Rule (U.S. Forest Service 2001), places restrictions for timber harvest and road construction or reconstruction within IRAs.

The SFMLRP area includes eight IRAs governed by the 2001 Roadless Conservation Rule. These IRAs comprise approximately 24,613 acres of the 49,786-acre SFMLRP area (Table 3.46). There are a total of 8.23 miles of existing classified roads within the IRAs found in the Project area

Table 3.46. Inventoried Roadless Area Acreages and Miles of Road in the Project Area

IRA Name	Total Acreage of IRA	Acreage within Project Area	Miles of Road* within IRAs of the Project Area
Rancho Viejo	3,827.0	231.3	–0
Pacheco Canyon	1,011.9	384.3	–0
Thompson Peak	33,001.6	13,061.5	5.26
Tesuque Creek	810.4	727.7	–0
Juan de Gabaldon Grant	8,023.4	7,876.0	2.21
Black Canyon	1,921.5	1,148.5	–0
Little Tesuque	814.8	814.3	0.04
McClure Reservoir	375.4	369.4	0.72
Total	**49,786**	**24,613**	**8.23**

*includes Level 1 roads (basic custodial care, closed), Level 2 roads (high-clearance vehicles), and Level 4 roads (moderate degree of user comfort).

Values and Features that characterize IRAs

The 2001 Roadless Rule identifies nine values and features that characterize IRAs. These nine characteristics are:

1. High quality or undisturbed soil, water, and air.
2. Sources of public drinking water
3. Diversity of plant and animal communities
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 Non-Motorized, 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
9. Other locally identified unique characteristics

The affected environment for the nine values and features used to characterize overall are representative of the general project area without any outstanding features unless specified below.

HIGH QUALITY OR UNDISTURBED SOIL, WATER AND AIR

The SFNF's GIS data show that the soils in the IRAs are in moderate or severe condition (Table 3.47).

Table 3.47. Erosion Hazard Ratings in the Inventoried Roadless Areas of the Project Area

IRA Name	Soil Rating	Area (acres)
Rancho Viejo	Moderate	47.36
	Severe	183.89

IRA Name	Soil Rating	Area (acres)	
Pacheco Canyon	Moderate	98.74	
	Severe	285.56	
Thompson Peak	Moderate	5,942.52	
	Severe	183.89	
Tesuque Creek	Moderate	727.66	
Juan de Gabaldon Grant	Moderate	2,436.44	
	Severe	5,439.44	
Black Canyon	Moderate	389.29	
	Severe	759.26	
Little Tesuque	Moderate	67.69	
	Severe	746.65	
McClure Reservoir	Moderate	327.77	
		Severe	41.63

The SFNF's GIS data show that the subwatersheds in the IRAs of the project area are primarily functioning at risk, with the exception of Arroyo Hondo, which is functioning properly (Table 3.48).

Table 3.48. HUC 12s Located within the IRAs of the Project Area

IRA Name	HUC 12	Watershed Condition Class
Rancho Viejo	Rio Nambe	Functioning at Risk
Pacheco Canyon	Rio-Tesuque-Pojoaque Creek	Functioning at Risk
	Headwaters Rio Tesuque	Functioning at Risk
Thompson Peak	Headwaters Rio Tesuque	Functioning at Risk
	Dry Gulch-Pecos River	Functioning at Risk
	Arroyo Hondo	Functioning Properly
	Headwaters Santa Fe River	Functioning at Risk
	San Cristobal Arroyo-Galisteo Creek	Functioning at Risk
Tesuque Creek	Headwaters Rio Tesuque	Functioning at Risk
Juan de Gabaldon Grant	Headwaters Rio Tesuque	Functioning at Risk
Black Canyon	Headwaters Rio Tesuque	Functioning at Risk
Little Tesuque	Headwaters Rio Tesuque	Functioning at Risk
McClure Reservoir	Headwaters Santa Fe River	Functioning at Risk

There are three Class I areas managed for high air quality in northern New Mexico; Bandelier Wilderness, San Pedro Parks Wilderness, Pecos Wilderness and Wheeler Peak Wilderness. There are no areas within the project boundaries or any of the IRAs that are specifically managed for high air quality (U.S. Forest Service 2021l).

SOURCES OF PUBLIC DRINKING WATER

The SFNF's GIS data show that there is one public water supply intake located within the project area; however, this intake is not located directly within an IRA.

DIVERSITY OF PLANT AND ANIMAL COMMUNITIES AND HABITAT FOR THREATENED, ENDANGERED, PROPOSED, CANDIDATE, AND SENSITIVE SPECIES AND THOSE SPECIES DEPENDENT ON LARGE, UNDISTURBED AREAS OF LAND

The project area, and the IRAs within it, are currently occupied by many species including the MSO, a federally listed threatened species, and 12 SCC (Appendix B). There are currently five MSO PACs identified in the project area. Of the five MSO PACs, three are wholly or partially located within IRAs. One is located within the Juan de Gabaldon IRA in its entirety and two are located within the Thompson Peak IRA, although both are only partially within the project boundary. The current risk for large, high-severity fire also poses a substantial threat to MSO habitats across the project area.

The project area is dominated by tree stands (ponderosa, mixed conifer, spruce-fir, pinyon-juniper and riparian) that are increasing in density over time. The majority of these trees are small diameter in the understory, often growing in shade, thus stunted and at risk for disease. Over time, wildlife habitats are changing, becoming less suitable as diversity decreases, conifer density increases and risk for large, high-intensity, high-severity wildfires increase across the Forest. This condition limits the diversity and quality of wildlife habitat.

The absence of low-intensity fire has promoted this in-fill of small trees and has contributed to the accumulation of surface fuel loads in the project area. The combination of the dense vegetation, high fuel loads, and presence of ladder fuels results in an increased risk for uncharacteristically severe wildfire which could drastically alter vegetation communities and thus wildlife habitats. In addition, the high vegetation densities increased the risk of insect and disease outbreaks, coupled with drought stress can lead to widespread tree mortality, again risking habitat alteration.

The vegetation within and immediately adjacent to the project area also consists of a diversity of other types and conditions. These include mixed conifer and aspen overstory types and understory types of upland vegetation such as grasses and small shrubs. The vegetation also consists of uneven-aged trees, some with a more open canopy. Refer to section 3.5 Flora and Fauna section of this document for more information.

PRIMITIVE, SEMI-PRIMITIVE NON-MOTORIZED, AND SEMI-PRIMITIVE MOTORIZED CLASSES OF DISPERSED RECREATION

The presence of primitive, semi-primitive non-motorized, and semi-primitive motorized classes of dispersed recreation across the IRAs of the project are identified below (Table 3.49). Other classes of dispersed recreation, including rural and roaded natural, are also found within the IRAs (U.S. Forest Service 2021l).

Table 3.49. Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized Classes of Dispersed Recreation in the IRAs of the Project Area

IRA Name	Recreation Opportunity Spectrum	Area (acres)
Rancho Viejo	Primitive	231.3
Pacheco Canyon	Semi-Primitive Motorized	103.97
	Semi-Primitive Non-Motorized	280.33

IRA Name	Recreation Opportunity Spectrum	Area (acres)
Thompson Peak	Primitive	1,875.47
	Semi-Primitive Motorized	75.46
	Semi-Primitive Non-Motorized	10,739.37
Tesuque Creek	Semi-Primitive Motorized	20.37
	Semi-Primitive Non-Motorized	491.98
Juan de Gabaldon Grant	Semi-Primitive Motorized	2.38
	Semi-Primitive Non-Motorized	7,237.49
Black Canyon	Primitive	23.60
	Semi-Primitive Non-Motorized	943.79
Little Tesuque	Semi-Primitive Non-Motorized	694.16
McClure Reservoir	Primitive	123.14
	Semi-Primitive Non-Motorized	246.25

REFERENCE LANDSCAPES

"Reference landscapes of relatively undisturbed areas serve as a barometer to measure the effects of development on other parts of the landscape" (U.S. Forest Service 2001 Roadless Area Final Rule, p.3245). The current SFNF Plan does not identify any reference landscapes. The IRAs within the project area are not suitable reference landscapes because their conditions do not represent desired conditions for ecosystem composition, structure, or processes (U.S. Forest Service 2021l).

NATURAL APPEARING LANDSCAPES WITH HIGH SCENIC QUALITY

The SFMLRP footprint is the backdrop to the Santa Fe, NM and surrounding areas. The natural landscapes of the southern Sangre de Cristo Mountains are highly attractive feature for tourism, recreation and locals living in the area. Most of the project area, including all eight IRAS, are rated for scenic attractiveness as Category A- landform, vegetation patterns, water characteristics, and cultural features combine to provide unusual, unique, or outstanding scenic quality (U.S. Forest Service, 2020g). The SFNF Scenic Integrity Objective map (Figure 3.24) shows the existing scenic integrity as very high or high of the IRAs. Which is described as "unaltered" or "appears unaltered". The 2022 SFNF Forest Plan defines IRA desired conditions as appearing natural, having high quality scenic quality and provide opportunities for primitive recreation and solitude.

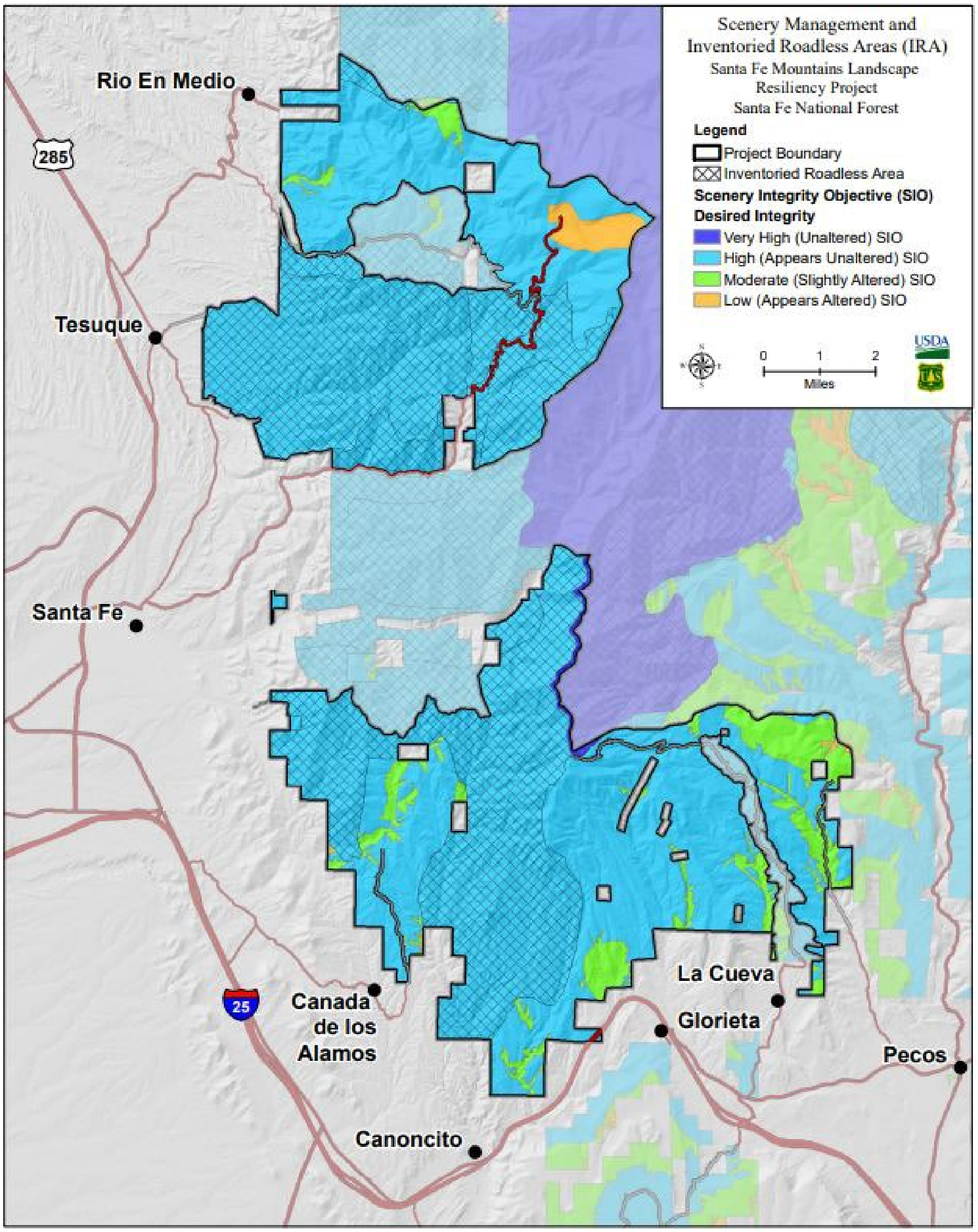


Figure 3.24. Scenic Integrity Objective Map for Inventoried Roadless Areas.

TRADITIONAL CULTURAL PROPERTIES AND SACRED SITES

The SFMLRP Phase 1 Literature Review (Campbell and Comstock 2021) revealed 80 previously recorded archaeological sites within the project area (U.S. Forest Service 2021l).

OTHER LOCALLY IDENTIFIED UNIQUE CHARACTERISTICS

The SFMLRP IDT has identified Thompson Peak, Black Canyon, Juan de Gabaldon and Tesuque Creek IRAs contain locally unique features. The Thompson Peak IRA has the possible southernmost extent of the bristlecone pine species, high-level natural quality, three reaches with pure cutthroat trout (Regional Forester's sensitive species) are present. The Nationally recognized hiking trail, Windsor Trail, starts in the Juan de Gabaldon IRA into the Tesuque Creek IRA and eventually heads into the Pecos Wilderness. The Black Canyon IRA has a unique recreation opportunity near the Aspen Vista Picnic Area and Trailhead where the public can enjoy the vast aspen stand changing colors during the early fall.

3.14.2 Environmental Consequences

Methods and Assumptions Used for Analysis

This analysis is based on spatial and Geographic Information System data from the SFNF. The spatial boundaries for evaluating the direct/indirect and cumulative effects on IRAs include the broader boundary for all the IRAs that are wholly within, or partially within the project boundary so that potential impacts to individual IRAs can be assessed.

For this report, the definition of a short-term impact is 1 to 5 years because immediate fire effects are expressed during this time period, such as the response of herbaceous plants and shrubs. The definition of a long-term impact is 6 years and beyond because the structure and composition of vegetation recover from fire effects by this time.

Impacts to the character of IRAs from the alternatives (No Action Alternative and Proposed Action) are analyzed by qualitatively assessing the nine characteristics of roadless areas, as defined in the 2001 Roadless Rule (Table 3.50).

Table 3.50. Resource Condition Indicators and Measures for Assessing Effects

Issue	Indicator or Measure	Source
Changes to the character of IRAs	Assessment of each proposed management activity's impact to the nine roadless characteristics (qualitative and quantitative)	2001 Roadless Area Conservation Rule (36 CFR Part 294)

Alternative 1: No Action Alternative

Under the No Action Alternative, current management plans would not authorize any specific actions and continue to guide the management of the project area. No prescribed burning, vegetation and restoration treatments, or road closure, would be implemented to accomplish project goals within the project area, unless approved through a separate NEPA document and decision. Without implementing the treatments, forest conditions would continue to depart from desired conditions. The risk of uncharacteristic fire severity would continue to increase within the project area. Forest structure would continue to be somewhat homogenous and would continue to be dominated by a single age class. Forests would lack the desired level of diversity in structure, composition, and density. Forest susceptibility to insects and disease (e.g., bark beetles and mistletoe) would continue to increase. Ultimately, the landscape would not be moved toward desired conditions, and as such, the No Action Alternative would not meet the purpose and need for the project (U.S. Forest Service 2021l).

HIGH QUALITY OR UNDISTURBED SOIL, WATER, AND AIR.

Without treatment to fuels and forest structure, ground cover would be expected to remain deficient beneath areas of dense canopy, and the persistent and elevated risk of large, high-intensity wildfire would continue to threaten water quality, soil productivity, and flooding. High-intensity wildfire would negatively impact the soil and water of the IRAs. Potential impacts include altered soil productivity, altered water-balance, decreasing infiltration, increasing overland flow and stream-flow, and increasing erosion and sedimentation. Refer to the environmental consequences for Soil and Water Resources in Chapter 3 of the draft EA for more detailed information on the effects of the No Action Alternative to soil and water throughout the project area. Effects in the IRAs are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

Air quality in the project area is generally in good condition or improving as most pollutants are decreasing as a result of stricter regulation. However, impacts to visibility and ambient air quality conditions associated with PM are expected to increase as a result of larger, more severe wildfires and increases in fugitive dust as the effects of climate change are realized (U.S. Forest Service 2021l). See Section 3.8 for more detailed information on the effects of the No Action Alternative to air quality throughout the project area. Effects in the IRAs are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

SOURCES OF PUBLIC DRINKING WATER

The increased potential for a severe wildfire could cause severe soil erosion, which would potentially affect water quality and drinking water supplies of downstream communities for decades. See Section 3.6 for more information on the effects of the No Action Alternative on sources of public drinking water throughout the project area. Effects in the IRAs are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

DIVERSITY OF PLANT AND ANIMAL COMMUNITIES AND HABITAT FOR THREATENED, ENDANGERED, PROPOSED, CANDIDATE, AND SENSITIVE SPECIES AND FOR THOSE SPECIES DEPENDENT ON LARGE, UNDISTURBED AREAS OF LAND

Without treatments, existing trends towards increased densities of smaller trees and conifer encroachment/infill would continue and wildlife habitats would become less suitable as diversity decreases, conifer density increases and risk for large, high-intensity, high-intensity wildfires increases across the Forest. The risk for large, high-intensity fire would pose a substantial threat to MSO habitats across the project area.

See Sections 3.4 and 3.5 for detailed information on the effects of the alternatives on MSO, goshawk, and other wildlife species. Effects in the IRAs are not discernibly different from the rest of the project area. Information on MSO habitat may also be found in Section 3.4.

PRIMITIVE, SEMI-PRIMITIVE NON-MOTORIZED, AND SEMI-PRIMITIVE MOTORIZED CLASSES OF DISPERSED RECREATION

Without treatment, a high-intensity wildfire has the potential to cause major impacts to recreation settings, opportunities, and existing recreation experience. A high-intensity wildfire may reduce access to primitive, semi-primitive non-motorized, and semi-primitive motorized areas with the IRAs and the quality of recreational experiences would be negatively impacted. If these areas were closed due to wildfire, recreation users would be impelled to seek alternative locations to pursue the same activity.

Please refer to Section 3.9 of this EA for detailed information on the effects of the No Action Alternative on the ROS classes. Effects in the IRAs are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

REFERENCE LANDSCAPES

Since no reference landscapes are identified, there would be no effect on this characteristic of IRAs.

NATURAL APPEARING LANDSCAPES WITH HIGH SCENIC QUALITY

Vegetative conditions would continue to depart from the desired structure and composition that are characteristic of the forests found within the IRAs. This would result in forests are visually denser and homogenous, lacking the desired structural diversity. The risk of uncharacteristic fire severity would continue to increase within the project area. A high-intensity wildfire would dramatically alter the scenic quality and natural appearance of the landscape, resulting in large-scale removal of vegetation across the landscape and negatively impacting the scenic quality. See Section 3.10 for detailed information on the effects on scenic quality from the No Action Alternative. Effects in the IRAs are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

TRADITIONAL CULTURAL PROPERTIES AND SACRED SITES

A high-intensity wildfire has the potential to damage or destroy the traditional cultural properties and sacred sites that exist within the IRAs. Please refer to Section 3.11 and Section 3.12 for a discussion of impacts from the No Action Alternative to heritage resources and to tribal and traditional uses, respectively. Effects in the IRA are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

OTHER LOCALLY IDENTIFIED UNIQUE CHARACTERISTICS

The identified locally unique characteristics found in the Thompson Peak, Black Canyon, Juan De Gabaldon, and Tesuque Creek IRAs would maintain unchanged from the No Action Alternative. These unique features would remain at risk of loss or degrade from future disturbances.

Alternative 2: Proposed Action

Prescribed fire, riparian restoration, manual and mechanical thinning treatments would occur within all eight of the IRAs within the project area. The vegetation types subject to treatment include mixed conifer–frequent fire, ponderosa pine forest, pinyon-juniper woodland, pinyon-juniper grassland, juniper grasslands, and narrowleaf cottonwood/shrub.

The restoration methods applied within the IRAs would use equipment and vehicles that that do not require the use new access roads (Soil-1, Soil-3). The project proposes up to 18,000 acres of mechanical or hand-thinning treatments, up to 38,000 acres of prescribed burning, up to approximately 680 acres of riparian restoration, and 1.5 miles of road closure. Mechanical treatment would only occur on slopes with gradients less than 40 percent; manual treatments could occur on all slopes. Approximately 11,732 acres of the IRAs occurs on gradients less than 40 percent. The U.S. Forest Service estimates that no more than 750 acres per year (3% of total IRA acres) would be treated with manual or mechanical vegetation thinning and no more than 4,000 acres per year (16% of total IRA acres) would be treated by the use of prescribed fire.

Restoration activities would focus on thinning and burning treatments to improve forest health and resiliency by reducing fuel loading, stand density, continuity, and homogeneity (sameness of forest structure and species composition), and increasing heterogeneity (diverse forest structure and species composition) at a landscape scale, mid-scale, and fine scale. No permanent or temporary roads would be constructed, but existing roads, trails, and routes may be used for access. Overland travel by vehicles that do not require roads to be constructed (e.g., masticators, UTVs) may occur (U.S. Forest Service 2021l).

The predominant vegetation types found within the IRAs of the project area, as described by ERUs, are identified in Table 3.51 below. These vegetation types are not unique to the IRAs within the project area and not all vegetation types are proposed for treatments in the SFMLRP.

Table 3.51. Vegetation Types Proposed for Treatment within the Inventoried Roadless Areas

IRA Name	Vegetation	Acreage within Project Area
Rancho Viejo	Mixed Conifer – frequent fire	47
Rancho Viejo	Pinyon-Juniper Woodland	48
Rancho Viejo	Ponderosa Pine Forest	136
	Total	**231**
Pacheco Canyon	Mixed conifer – frequent fire	94
Pacheco Canyon	Pinyon-Juniper Woodland	169
Pacheco Canyon	Ponderosa Pine Forest	117
	Total	**380**
Thompson Peak	Mixed Conifer – frequent fire	4,529
Thompson Peak	Pinyon-Juniper Woodland	669
Thompson Peak	Ponderosa Pine Forest	6,186
	Total	**11,384**
Tesuque Creek	Mixed Conifer – frequent fire	634
	Total	**634**
Juan de Gabaldon Grant	Mixed Conifer – frequent fire	1,934
Juan de Gabaldon Grant	Pinyon-Juniper Woodland	4,211
Juan de Gabaldon Grant	Ponderosa Pine Forest	1,239
	Total	**7,384**
Black Canyon	Mixed Conifer – frequent fire	345
Black Canyon	Ponderosa Pine Forest	9
	Total	**354**
Little Tesuque	Mixed Conifer – frequent fire	47
Little Tesuque	Pinyon-Juniper Woodland	348
Little Tesuque	Ponderosa Pine Forest	399
	Total	**794**
McClure Reservoir	Mixed Conifer – frequent fire	326
McClure Reservoir	Ponderosa Pine Forest	42
	Total	**368**

HIGH QUALITY OR UNDISTURBED SOIL, WATER, AND AIR

Short-term adverse impacts to soil, water, and air quality could occur as a result of increased erosion potential arising from ground disturbance related to vegetation thinning and prescribed fire treatments. The adverse impacts would be outweighed by the long-term benefits to watershed resources and would be mitigated by the design features developed for the project. This project is also expected to reduce risks of high-severity, stand-replacing wildfires; thereby resulting in long-term beneficial impacts to soil function and watershed conditions across all 24,613 acres of IRA within the SFMLRP area.

The use of prescribed fire may cause some erosion (and sedimentation) but is unlikely to cause more erosion on steeper slopes than typical slopes during an average precipitation year. The potential for adverse effects on soil and watershed processes by mechanical equipment and prescribed fire should be diminished by the effective implementation of project design criteria. Adverse impacts to watershed resources are expected to be minimal, short term, and insignificant when compared with those by high-intensity wildfire. Please refer to Section 3.6 for more information on the effects of the Proposed Action on soil and water throughout the project area. Effects in the IRAs are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

Implementation of the Proposed Action would reduce future wildfire smoke emissions and air quality impacts and mitigate the potential long-term loss of stored carbon. Mechanical fuel treatments and prescribed fire would have minimal impacts on air quality. The impact of smoke on local community members and visitors would depend on weather conditions when fires are active and an individual’s sensitivity to smoke. The U.S. Forest Service would take measures to manage smoke impacts resulting from prescribed fire. Please refer to Section 3.8 of this EA for more detailed information on the effects of the Proposed Action alternative on air quality throughout the project area. Effects in the IRAs are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

SOURCES OF PUBLIC DRINKING WATER

National forests in New Mexico were established, in part, to protect sources of water which flow from the mountains through forested areas down to the valleys and deserts. Precipitation that falls on National Forest lands infiltrate into the groundwater and can provide drinking water to residents using wells. Vegetation and watershed restoration both within IRAs and outside of IRAs is expected to improve filtration and reduce the risk of the increased sedimentation caused by uncharacteristic wildfires.

Impacts to the IRAs’ characteristic of sources of public drinking water is expected to be beneficial over the long term when compared to the No Action Alternative. Please refer to Section 3.6 for more information on the effects of the Proposed Action alternative on watershed resources throughout the project area. Effects in the IRAs are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

DIVERSITY OF PLANT AND ANIMAL COMMUNITIES AND HABITAT FOR THREATENED, ENDANGERED, PROPOSED, CANDIDATE, AND SENSITIVE SPECIES AND FOR THOSE SPECIES DEPENDENT ON LARGE, UNDISTURBED AREAS OF LAND

Varying Ecological Response Units exist in the project area, from mixed conifer, ponderosa pine to pinyon-juniper, and grasslands to riparian areas along streams, and a variety of plant and animal species occupy these habitats. Overall, treatments are aimed at making habitats for wildlife species more resilient to disturbances such as wildfire and improving diversity of plant and animal communities.

The two most dominate plant communities or ERUs within the project are Mixed Conifer- Frequent Fire Forests and Ponderosa Pine Forests. Both ERUs are highly departed from historical conditions due to decades of fire exclusion and past management practices leading to higher stand densities, altered stand structure, and deficient in large old trees. Mixed Conifer- Frequent fire forests densities Current densities in Mixed Conifer- Frequent Fire Forest vegetation type has approximately 503 trees per acre (TPA) and an average basal area (BA) of 157. While Ponderosa Pine Forests vegetation type current densities are approximately 543 TPA and an average BA of 142. With these trends, wildlife habitats are changing, becoming less suitable as diversity decreases, conifer density increases, and risk for large, high-intensity, high-severity wildfires increase across the Forest. The desired tree density within Mixed Conifer Frequent Fire ERU would generally range from 30 to 125 square feet per acre BA and Ponderosa Pine ERU would range from 22 to 89 square foot BA per acre respectfully. These ERUs are currently in the mid to late closed Seral Stages, which include small to medium sized trees with a >30% closed canopy. The project is focused by moving the stand structure and composition to a majority late open seral stage, comprising of medium- large trees and <30% canopy cover The Project has an overall diameter limit of 16' DBH and 12" DRC for pinon/ juniper. However, within the IRAs the proposed action would focus on generally small diameter trees (5- 9.9 inches DBH). By focusing on the small diameter trees within mid-closed and late-closed seral stages of the ERUs the proposed action would be able to shift the structure and composition of the stands closer to their desired conditions. Being majority of Late-Open seral stage inside all the IRAs as well as across the Project area. Refer to Chapter 3.2 for more information and detail each ERU Seral Stages

Thinning and prescribed fire treatments are expected to have a stimulating effect on herbaceous understory, improve forage, reduce woody debris and recycle nutrients to the soil (U.S. Forest Service 2021l). Some short-term negative impacts may occur (e.g., a temporary reduction in herbaceous cover after prescribed burning, and wildlife may be temporarily displaced during project implementation, but would be expected to recolonize treated areas once treatment activities cease). Although direct impacts to individuals may occur in the short term, treatment is expected to improve habitat suitability and forage availability over the long term. No impacts to species trends are expected.

Mexican Spotted Owl (MSO) normally occupies old-growth forest in mixed conifer, pine-oak woodland, deciduous riparian, or a combination of these habitats that will support a home range of 1,400 to 4,500 acres (USFWS 2012). Three MSO PACs located within IRAs of the SFMLRP Project Area. One is located within the Juan de Gabaldon IRA and two are partially located within the Thompson Peak IRA (both are only partially within the project boundary). In the long term by increasing landscape resiliency and meeting the desired conditions in section 1.4 of the EA the SFNF will be able to improve MSO habitats with the IRAs and project area respectfully. The proposed action would focus on small diameter tree cutting and low intensity prescribed fire using the mitigation measures such as Wild- 1 thru Wild- 3, MSO- 2, MSO-5, MSO- 7, MSO- 11 to reach the stand structure, composition and densities to reach the desired condition as described in Appendix A of the Final EA. These project mitigation measures are in guidance with the 2022 SFNF Forest plan and MSO Recovery plan, that clearly define characteristics on species habitat including but not limited to structure and composition, diameter specifics and targeted basal area.

There are twelve Species of Conservation Concern that exist within the project area. The project area and the analysis area contains particular habitat types as well as dispersed suitable habitat for SCC. The proposed action would improve the general wildlife habitat and move the landscape to the desired conditions. The long-term benefits of focusing on smaller diameter tress cutting as well as creating resiliency on the landscape would create an older age class structure, a mosaic of vegetation densities and canopy gaps to further improve the general wildlife habitat.

The Proposed Action would move these landscapes and ERUs to the desired conditions leading to more resilient forests, greater ecosystem health, diversity of native and desired non-native plant and animal communities. The vegetation communities would be composed of multiple species of varying ages in a mosaic of seral states and structures. The forest arrangement on the landscape would be similar to historic patterns, with groups and patches generally of variably sized and aged trees (uneven-aged and) and occasional patches of even-aged structure interspersed within variably sized openings of grass-forb-shrub vegetation. Restoring forest structure, and openings would stimulate the growth of an herbaceous understory that provides forage, while still retaining areas of denser growth and closed canopy would provide a diversity of habitat types for multiple species.

Overall, the Proposed Action may result in some adverse and short-term impacts to wildlife immediately following the proposed treatment activities, but impacts are expected to be beneficial over the long term when compared with the No Action Alternative. Leading to both characteristics of diversity of plant and animal communities and habitat for threatened or endangered species improving in direct result from described long term benefits.

Please refer to the BA or Section 3.5 for detailed information on the effects of the Proposed Action alternative to MSO, other wildlife species. Effects in the IRAs are not discernibly different from the rest of the project area (U.S. Forest Service 2021m).

PRIMITIVE, SEMI-PRIMITIVE NON-MOTORIZED, AND SEMI-PRIMITIVE MOTORIZED CLASSES OF DISPERSED RECREATION

The Proposed Action could cause short-term, minor to moderate impacts to site-specific recreation sites. Noise from restoration activities and views of workers, equipment, vehicles, or debris and cleared areas could temporarily and adversely impact the experience of recreationists in dispersed settings. The desired condition of a healthier, more resilient forest would also result in a forest that is more open in character than the current landscape and would offer more dispersed recreation opportunities like hunting, hiking, and wildlife viewing.

Impacts to the IRAs' characteristic of dispersed recreation is expected to be adverse and short term and beneficial over the long term when compared with the No Action Alternative.

Please refer to Section 3.9 for more information on the effects of the Proposed Action on recreation. Effects in the IRAs are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

REFERENCE LANDSCAPES

Since no reference landscapes are identified, the Proposed Action would have no effects on this characteristic of IRAs. However, the proposed treatments would move vegetative conditions in the project area, including the IRAs, closer to suitable conditions for a potential reference landscape (U.S. Forest Service 2021l).

NATURAL APPEARING LANDSCAPES WITH HIGH SCENIC QUALITY

The IRAs within the SFMLRP fall within the West Range character type, characterized by mountains that have highly dissected slopes, sharp angular ridgetops, and deep V-shaped canyons. The proposed management activities would move the landscape character to include more open stands typical of this elevation and vegetation type (U.S. Forest Service 2021l).

The Proposed Action purpose and need are to maintain this natural appearing landscape and create resiliency against future disturbances that could drastically alter the landscape. Large, uncharacteristic wildfire, climate change and insect outbreaks could reduce the scenic integrity and attractiveness surrounding Santa Fe communities. Retaining the high scenic quality within the eight IRAs in the SFMLR Project area management objectives of at least high is crucial to meet desired conditions. The treatments would affect the short-term appearance during implementation, as a result of tree removal, slash piles, and burned vegetation. However, the IRAs would still appear natural. No artificial structures or new roads would be added that would reduce the appearance of a natural landscape. The high scenic quality would be protected by reducing the threat of a high-severity, stand-replacing wildfire, which could diminish the scenic quality for a long period of time. However, low to moderate-intensity fire would improve the natural appearance by creating small openings and encouraging grass and forb growth.

Impacts to the IRAs' characteristic of natural appearing landscapes with high scenic quality is expected to be adverse and short term and beneficial over the long term when compared with the No Action Alternative. Please refer to Section 3.10 for more information on the effects on scenic quality. Effects in the IRAs are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

TRADITIONAL CULTURAL PROPERTIES AND SACRED SITES

The removal of trees will reduce long-term fuel continuity, fuel loading, and fire hazard. This type of treatment will benefit cultural resources within the project area by decreasing the potential for adverse effects caused from high-intensity, high-severity wildfires. Traditional cultural areas would be avoided by all ground-disturbing mechanized activities associated with the project. Cultural sites would be avoided by other project activities, or fire would be allowed to burn over cultural resources, depending on the type and nature of the sites. In the short term, the treatments could lead to accelerated erosion which may damage cultural properties and sacred sites; increased visibility of cultural resources caused by removal of vegetation may substantially increase inadvertent or advertent looting activities.

Impacts to the IRAs' characteristic of TCPs and sacred sites is expected to be adverse and short term and beneficial over the long term when compared to the No Action Alternative. Please refer to Section 3.12 for more information on traditional cultural properties and sacred sites. Effects in the IRA are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

OTHER LOCALLY IDENTIFIED UNIQUE CHARACTERISTICS

The Thompson Peak IRA has several unique features are identified for this area including rare plant or animal communities, and high-quality water resources. First is having the possible southernmost extent of the bristlecone pine species and would be preserved from the Proposed Action Alternative. It is also known for its high-level natural quality except for invasive weeds in some disturbed areas. Only a few closed roads are visible off the eastern edge. There are three reaches with pure cutthroat trout (Regional Forester's sensitive species) present. (SFNF Land Management Plan, Vol. 3). Through the proposed action and moving the landscape towards the desired conditions will reduce the risk of uncharacteristic wildfire and maintain the ecological processes found within the project area. High severity and/or uncharacteristic wildfires could damage or remove these rare plant and animals from the IRA and damage the natural quality found in the Thompson Peak IRA The resiliency created in the Thompson Peak IRA and surrounding landscape will aid in the preservation, health and have long lasting benefits to the unique characters found in the IRA to withstand future disturbances. .

The Spruce Fir ERU which is found in the Thompson Peak IRA and Black Canyon IRA. This ERU species composition is described in the 2022 SNF Forest plan. Lower-elevation spruce-fir resembles wet mixed conifer with a different composition of tree species, due to relatively warmer, drier conditions, and is a transition zone between wet mixed conifer and the upper-elevation spruce-fir forest type. In the lower type, common seral tree species are aspen, Douglas-fir, white fir, and southwestern white or limber pine. Late seral forest is dominated by Engelmann spruce, white fir, and occasionally blue spruce. Subdominant species may include corkbark (subalpine fir), white fir, and bristlecone pine. In the upper type, dominant tree species are Engelmann spruce, corkbark fir (subalpine fir), but fir may be absent in the colder locations. Patches of aspen are occasionally present, but aspen is typically incidental or codominant. Occasional bristlecone pine is also present in the upper elevations. The Proposed Action does not include treatment in spruce fir forest ERU. However, treatments in adjacent ERUs are focused upon mitigating potential fire spread into the spruce fir ERU (Section 1.4.1 Final EA). Not targeting the Spruce Fir ERU inside the Thompson Peak IRA while improving the ecosystem resilience in the adjacent ERUs to future disturbance the proposed action will preserve and maintain the southernmost extent of the Bristlecone Pines.

The Nationally recognized hiking trail, the Windsor trail, which starts in the Juan de Gabaldon IRA and run through the Tesuque Creek IRA then finally runs through the Pecos Wilderness. This trail is used by a multitude of individuals and uses. The proposed action will maintain the high- level of natural quality found along the trail and surrounding area. the proposed action would have short-term adverse impacts on the use of such heavily used trails during implementation. The closure of areas during possible thinning or prescribed burn treatments. But the long-term benefits from the treatments would benefit the recreational uses of these trails and areas. The desired conditions would lead to on a forest more open in character creating better views of the surround landscapes and reduce the risk of high severity fires that could possibly close trails long term or permanently, such as the Rio en Medio Trail after the Medio Fire in 2020.

In the fall the area around Aspen Vista Picnic Area and Trailhead is an awesome place where individuals and groups can enjoy a large stand of aspens as the colors change. Part of this large aspen stand is found in the Black Canyon IRA which provides for this unique recreation opportunity. The project does not focus on the cutting of deciduous trees, except the areas found in the Narrow Leaf Cottonwood ERU (Tesuque Creek and Arroyo Hondo Drainages). The project focuses on cutting the smaller diameter trees that could be encroaching on this aspen stand which could eventually change the stand to coniferous dominated stand. The proposed action would help maintain the natural quality of the area and provide better opportunities for hunting, hiking and wildlife viewing in these areas.

Cumulative Effects

The temporal boundary for analyzing cumulative effects is 20 years in order to account for subsequent maintenance burning that would follow initial treatments. The Proposed Action does not include road construction within IRAs. The Pacheco Canyon Forest Resiliency Project (2,042 acres) and the Hyde Park WUI Project (1,840 acres) are ongoing projects adjacent to the SFMLRP area that include thinning and prescribed burning activities within IRAs. For the Pacheco Canyon Project, 808 acres of the 2,042 acres are within IRAs. The entirety of the 1,840-acre Hyde Park Project is within IRAs. The Santa Fe Municipal Watershed Project (7,270 acres) includes ongoing maintenance prescribed burning within the Nichols Reservoir and a small portion of the Thompson Peak IRAs. These projects would have similar short-term and long-term impacts to IRA characteristics as described above; while some short-term impacts may be adverse, there are long-term benefits to many affected resources. Cumulatively, these projects along with the SFMLRP would improve the landscape’s resiliency to high severity wildfire and improve vegetative conditions.

The reader is referred to the cumulative effects for individual resources throughout EA Chapter 3 for more detailed information on cumulative effects. Cumulative effects for resources in the IRA are not discernibly different from the rest of the project area (U.S. Forest Service 2021l).

Summary

Since there would be no new roads constructed within the IRAs, there would be no change in the roadless character. The project would not forego any future management decisions for the IRA.

Impacts to the nine characteristics of IRAs, as described in detail above, vary depending upon the affected resource. While some short-term adverse impacts may occur, they are generally outweighed by the long-term benefits of the Proposed Action, including the reduced risk for high-severity wildfire. The adverse impacts would occur on less than 16% of the total IRA acreage within the project area and would generally be mitigated by the design features developed for the project. This project is also expected to reduce risks of high-severity, stand-replacing wildfires; thereby resulting in long-term beneficial impacts across all 24,613 acres of IRA within the SFMLRP area (U.S. Forest Service 2021l).

The SFNF received an exemption to the 2001 Roadless Rule; § 294.13 (b)1(ii) – Timber for the proposed treatments within the IRA areas the project from the Southwestern Region's Regional Forester. Which states; (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. (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.

This project falls under this exception given that the purpose and need of the project is to restore the characteristics of ecosystem composition and structure of the ERUs within the project area by improving the ecosystem resilience of this priority landscape to future disturbances. The general focus small diameter trees and treatments acreages annually are considered as infrequent by the Regional Forester. This will allow the proposed action to focus on the mid-closed and late-closed seral stages of the mixed conifer frequent fire, ponderosa pine, pinon/ juniper and riparian ERUs shifting the structure and composition closer to their desired future conditions to majority of late-open seral stages. The project will improve the roadless characteristic(s); 3 - Diversity of plant and animal communities and 4 - Habitat for threatened, endangered, proposed, candidate, and sensitive species and species dependent on large undisturbed areas of land because as identified in this analysis.

3.15 Environmental Justice

Executive Order 12898 (1994) requires federal agencies to address environmental justice of their actions on minority and low-income populations. This analysis considers demographic, economic, and human health risk factors. A specific consideration of equity and fairness in resource decision-making is encompassed in the issue of environmental justice and civil rights. As required by law and Executive Order, all Federal actions should consider potentially disproportionate effects on minority or low-income communities. Potential impact or change to low-income or minority communities within the study area due to the proposed action should be considered. Where possible, measures should be taken to avoid negative impacts to these communities or mitigate the adverse effects.

Native Americans have been present in the area for at least the past 1,000 years and Spanish settlers arrived in the area about 400 years ago. Many families in the study area trace their ancestry back to these original inhabitants. As such, there are strong ties to the land and a reliance on the natural resources of the forest.

Communities surrounding the Santa Fe area would fall under the minority and/or low-income populations identified in the Environmental Justice Executive Order 12898. The areas of concern: Santa Fe County, Chupadero, Tesuque, Tesuque Pueblo, Cañada de Los Alamos, Cañoncito, Glorieta, and La Cueva. Areas of concern: San Miguel County, Pecos, Upper La Posada, and Lower La Posada. Generally, environmental justice is concerned with identifying these communities and ensuring that they are involved in and understand the potential effects of the proposed action. The people in the study area communities are interested in maintaining their historic and subsistence landscape.

The project area is utilized by all the communities surrounding the City of Santa Fe. The proposed alternative focuses on areas that the small, minority low-income communities traditionally use. The project allows for fuelwood gathering which supports some local economy and a large source of local heat in the winter. The project is aimed at creating a resilient landscape against future disturbances. The proposed alternative would maintain and/or improve areas surrounding these communities by providing a more defensible landscape against large uncharacteristic wildfire, insects or disease and climate change. These disturbances would negatively affect these areas with flooding, loss of property, and create a shortage of resources that are important to these communities.

There might be short term impacts during implementation. These impacts include localized closures, limited access and possible smoke from prescribed fire. These impacts may be adverse but short in duration. The Forest Service will provide communication prior to implementation to the possible effected communities about timing and duration of the work. The long-term impacts are expected to outweigh the short-term impacts, as the potential negative impacts from the No Action Alternative have adverse long-term impacts.

Chapter 4. Consultation and Coordination

The U.S. Forest Service consulted the following federal, state, and local agency personnel; tribes; and other contributors during development of this analysis.

4.1 Interdisciplinary Team Members

Table 4.1. Interdisciplinary Team

Name	**Role**	**Title**
James Duran	Line Officer	SFNF Forest Supervisor (acting)
Bethany Ihle	Line Officer	SFNF Deputy Forest Supervisor
Sandra Imler-Jacquez	Line Officer	Española District Ranger
James Munoz	Line Officer	Pecos-Las Vegas District Ranger (acting)
Jacob Key	Team Leader	Fireshed Coordinator
Jean “Nikki” Berkebile	Archaeology	Pecos-Las Vegas District Archeologist
Jana Comstock	Archaeology	Española/Coyote Zone Archeologist
Jordan Jarrett	Archaeology	Española District Assistant Archeologist
Melvin “Danny” Burton	Biology	Pecos-Las Vegas District Wildlife Biologist
Dennis Carril	Fuels and Forestry	SFNF Fuels Program Manager
Gennaro Falco	Fuels and Forestry	SFNF Fuels Program Manager
Scott Williams	Fuels and Forestry	Enterprise, Fire Management Specialist (former)
Rian Ream	Fuels and Forestry	SFNF Prescribed Fire/ Fuels Technician
Lynn Bjorklund	Recreation/Scenery	Española District Recreation Program Manager
Charles Fothergill	Recreation/Scenery	Enterprise, Landscape Architect/ Recreation Planner (former)
Heidi Klingel	Watershed/Soils	Enterprise, Watershed Specialist (former)
Micah Kiesow	Watershed/Soils	SFNF Soils and Watershed Program Manager
Kerry Jones	Air Quality	SFNF Air and Water Quality Specialist
Devin Black	Climate Change	SFNF Ecosystems Project Coordinator
Michael Meyers	Range	Española/Coyote Zone Rangeland Management Specialist
David Anderson	Team Support	R3 Regional Office, Spatial Analyst
Jennifer Cramer	Team Support	SFNF Strategic Planning and Engagement Staff Officer
Antonia Batha	Team Support	Executive Assistant
June Galloway	Team Support	SFNF Environmental Coordinator (Detailer)
Brandon Glenn	Team Support	Española District Fire Management Officer
Joshua Hall	Team Support	SFNF Natural Resources Staff Officer
Julie Leutzelschwab	Team Support	SFNF GIS Coordinator
Matthew Littrell	Team Support	Enterprise, Forester
Reuben Montes	Team Support	SFNF Tribal Relations Specialist
Crystal Perez Gonzalez	Team Support	Enterprise, Silviculturalist

Jack Triepke	Team Support	R3 Regional Ecologist
Paul Czesynski	Team Support	Idaho Panhandle NF-St. Joe RD Forester Silviculturalist (detailer on the SFNF)
Andre Silva	Team Support	SFNF Wildlife Program Manager
Will Amy	Past Contributor	SFNF Wildlife Program Manager (former)
Bill Armstrong	Past Contributor	SFNF Fuels Program Manager (retired)
Anne Baldwin	Past Contributor	Española/Coyote Zone Archeologist (retired)
Hannah Bergemann	Past Contributor	NEPA/Collaboration specialist and SF Mountains Team Leader (former)
Amanda Campbell	Past Contributor	Enterprise, Supervisory Archaeologist
Rebecca Lloyd	Past Contributor	SFNF Watershed Program Manager (former)
Alberta Maez	Past Contributor	NEPA specialist and SF Mountains team leader (former)
Dave Park	Past Contributor	SFNF Watershed Program Manager (former)
Jon Williams	Past Contributor	SFNF Natural Resources Staff Officer (retired)
Sandy Hurlocker	Past Contributor	Española District Ranger (former)
Katie Brownson	Past Contributor	Fireshed Coordinator (former)
Justin Mapula	Past Contributor	Española District Wildlife Biologist (former)
Rachel Suazo	Past Contributor	Española/Coyote Zone Rangeland Management Specialist (former)
Erin Barton	Past Contributor	Santa Fe Forest Planner (former)
Jon Boe	Past Contributor	Española District Fire Management Officer (former)
Justin Mapula	Past Contributor	Española District Wildlife Biologist (former)
Steve Romero	Past Contributor	Pecos-Las Vegas District Ranger

4.2 Others

Table 4.2. SWCA Environmental Consultants

Name	Role	Title
Jennifer Clayton	Project Manager	Lead Environmental Planner
Coleman Burnett	Senior NEPA Advisor	Principal Environmental Planner
Victoria Amato	Assistant Project Manager	Natural Resources Planner/Fire Ecologist
Cody Stropki	Fire and Fuels Resource Advisor	Disaster and Resilience Director- Rockies Region
Paige Marchus	NEPA Advisor	Natural Resources Director- Albuquerque/ Four-Corners
Janet Guinn	NEPA Advisor	NEPA Project Manager
Max Weigman	NEPA support	Environmental Planner
Jennifer Wynn	NEPA Support	Environmental Planner
Jennifer Holeman	NEPA Support	Environmental Specialist
Hailey Henck	NEPA Support	Biologist
Anne Russel	GIS Support	GIS Specialist
Lili Perreault	NEPA Support	Assistant Project Ecologist

Name	Role	Title
Victoria Boyne	Administrative Record Manager	Administrative Support
Peggy Ford	Technical Editor	Technical Writer/Editor
Danielle Desruisseaux	Technical Editor	Technical Writer/Editor
Diane Bush	Technical Editor	Technical Editor
Heidi Orcutt-Gachiri	Senior Technical Editor	West Region Managing Technical Editor
Kimberly Proa	Formatter	Administrative Support

4.3 Agencies and Non-Governmental Organizations

4.3.1 Pre-NEPA Collaboration

In early 2016, the Coalition organized around a vision for the forests near Santa Fe. The ‘Santa Fe Fireshed’ became a term used by concerned government officials, scientists, and natural resource managers to describe this 107,000-acre landscape that they agreed is in critical need of restoration. The Fireshed spans multiple land jurisdictions including private land, tribal lands owned by the Pueblo of Tesuque, and public land managed by the U.S. Forest Service, the City of Santa Fe, and the State of New Mexico. Private lands under the jurisdiction of the New Mexico State Forestry Department are also a critical part of this landscape.

In this context, the SFMLRP was developed out of the following collaborative process:

- In May 2016, the Fireshed Coalition sponsored a community meeting to introduce the community to the idea of restoration in the Fireshed.
- During 2017, the Fireshed Coalition sponsored a series of presentations in Santa Fe to focus on fire awareness, including topics such as what are values at risk? What is forest restoration? What is a “controlled burn?” As residents, how can you reduce your own risk?
- In the fall of 2017, the Coalition hosted an open house to encourage the exchange of information, ideas, and concerns about the Fireshed. At this open house, the public was presented with the results of a risk assessment developed for the Coalition to show values at risk and how those values are related to current vegetation conditions.
- In early 2018, the Coalition sponsored another series of presentations covering “NEPA demystified,” “Smoke impacts of wildlife vs controlled fire,” “Post wildfire recovery,” and “wildfire preparedness.”
- During the summer of 2018, the Coalition presented a “Fire history of the Fireshed: A Wildfire Risk Assessment.” The presentation was held at three different locations on three different dates.
- In August 2018, the Coalition sponsored a “Learning Exchange” event to the Santa Fe Watershed boundary, through the Black Canyon Campground trail and the Hyde Park Project area.
- In November 2018, the Coalition sponsored a screening of the Multi-media Leaning experience “Era of Mega Fires” at the Jean Cocteau Cinema in Santa Fe. A panel discussion followed the screening.
- In December 2018, the SFNF sponsored a workshop to share the importance of the Santa Fe Mountains Project, to show on maps where the general area is located, and to ask for early concerns that may arise from the project. No specific treatments were proposed at this early, pre-NEPA meeting.

- Throughout 2019, 2020 and into 2021, the Coalition sponsored "Wildfire Wednesdays" to bring relevant topics to the Facebook live platform during the COVID restrictions.

4.3.2 NEPA

Following the December 2018 pre-NEPA meeting, the Santa Fe NF team proceeded to develop a Proposed Action for the SFMLRP. By June 2019, a scoping document was completed and shared with tribal governments and the public (U.S. Forest Service 2019).

- Greater Santa Fe Fireshed Coalition Government Agencies
    - City of Santa Fe
    - County of Santa Fe
    - Pueblo of Tesuque
    - New Mexico State Forestry
- The New Mexico State Historic Preservation Officer
- Tribal Governments:
    - Santo Domingo Pueblo
    - Cochiti Pueblo
    - Ohkay Owingeh
    - Nambe Pueblo
    - Pojoaque Pueblo
    - Santa Clara Pueblo
    - Pueblo de San Ildefonso
    - Pueblo of Tesuque
- Bureau of Land Management, Taos Field Office
- US Geological Survey
- Non-Government Organizations
    - Audubon Society
    - The Center for Biological Diversity
    - Defenders of Wildlife
    - Fat Tire Society
    - Forest Stewards Guild
    - Geos Institute
    - Great old Broads for Wilderness
    - Native Plant Society
    - New Mexico Wild
    - New Mexico Wilderness Alliance
    - The Nature Conservancy
    - Save our Forests and Ranchlands
    - Santa Fe Forest Coalition
    - Sierra Club
    - Trout Unlimited

- Wild Watershed
- Wild Earth Guardians
- The Wilderness Society

4.4 Native American Tribes

The SFNF has relationships with affiliated, sovereign Federally Recognized Native American tribes which are distinctly government-to-government. This entails biannual consultation to the Pueblos and communications throughout the year with the Pueblos via their governors. Under the 2022 SFNF Land Management Plan (U.S. Forest Service 2022b), the SFNF will consult with both tribal and traditional communities, taking into account impacts of projects to the lifeways of both. The government-to-government relationship between the U.S. Forest Service and federally recognized tribes is distinct from that of other interests and constituencies under a variety of Federal authorities. These authorities direct the agency to administer forest management activities and uses in a manner that is sensitive to traditional American Indian beliefs and cultural practices and are integral in our relationship with federally recognized tribes.

Treatments on and around known TCPs, sacred sites, and traditional use areas would be developed and implemented through ongoing consultation with Native American groups and other traditional communities throughout the life of this project. This consultation would take place during each implementation phase for proposed treatment units of the SFMLRP. Information about the location and current use of these sensitive areas would be incorporated into treatment unit planning and used to implement project-specific mitigation measures to protect sensitive sites.

As part of the NEPA scoping process, consultation letters were mailed to eight Pueblos: Cochiti Pueblo, Nambe Pueblo, Ohkay Owingeh Pueblo, Pojoaque Pueblo, San Ildefonso Pueblo, Santa Clara Pueblo, Santo Domingo Pueblo, and Pueblo of Tesuque. Pueblo of Tesuque provided a comment letter in response to scoping.

This page intentionally left blank.

Chapter 5. Literature Cited

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

All About Birds. 2021. Hairy Woodpecker Life History. Available at: https://www.allaboutbirds.org/guide/Hairy_Woodpecker/lifehistory. Accessed September 2021.

Allen, C.D., A.K. Macalady, H. Chenchouni, D. Bachelet, N. McDowell, M. Vennetier, T. Kitzberger, A. Rigling, D.D. Breshears, E.H. Hogg, P. Gonzalez, R. Fensham, Z. Zhang, J. Castro, N. Demidova, J.-H. Lim, G. Allard, S.W. Running, A. Semerci, and N. Cobb. 2010. A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests. *Forest Ecology and Management* 259:660–684.

Allen, C.D., M. Savage, D.A. Falk, K.F. Suckling, T.W. Swetnam, T. Schulke, P.B. Stacey, P. Morgan, M. Hoffman, and J.T. Klingel. 2002. Ecological restoration of southwestern ponderosa pine ecosystems: a broad perspective. *Ecological Applications* 12:1418–1433.

Andrews, P.L., F.A. Heinsch, and L. Schelvan. 2011. How to generate and interpret fire characteristics charts for surface and crown fire behavior. General Technical Report RMRSGTR-253. Fort Collins, Colorado: U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station.

Auchincloss, L.C., J.H. Richards, C.A. Young, et al. 2013. Inundation depth, duration, and temperature influence Fremont cottonwood (*Populus fremontii*) seedling growth and survival. *Western North American Naturalist* 72:323–333.

Bassett, S. 2018. *Greater Santa Fe Fireshed Coalition Wildfire Risk Assessment, Version 1.0*. Prepared by The Nature Conservancy for the Greater Santa Fe Fireshed Coalition. Available at: https://static1.squarespace.com/static/57b62cb1ebbd1a48387a40ef/t/5c741c30fa0d6043c21f47da/1551113274628/WRA.pdf. Assessed February 1, 2020.

Bates, J.D., R.F. Miller, and T.J. Svejcar. 2000. Understory dynamics in cut and uncut western juniper. *Journal of Range Management* 53(1): 119-126.

Beatty, J.S., and R.L. Mathiasen. 2003. *Dwarf Mistletoes of Ponderosa Pine*. Forest Insect & Disease Leaflet 40 (revised). Washington, D.C.: U.S. Department of Agriculture, Forest Service.

Biota Information System of New Mexico (BISON-M). 2021. Golden Eagle. Natural Heritage New Mexico. Available at: https://bison-m.org/booklet.aspx?SpeciesID=040372. Accessed August 2021.

Black, D., E. Barton, A. Rose, D. McKinley, and A. Dugan. 2022. Forest Carbon Assessment for the Santa Fe National Forest in the Forest Service's Southwest Region. White Paper. 36p.

Bolin, S.B., and T.J. Ward. 1987. Recovery of a New Mexico drainage basin from a forest fire. Forest hydrology and watershed management/edited by RH Swanson, PY Bernier & PD Woodard.

Brockway, D.G., R.G. Gatewood, and R.B. Paris. 2002. Restoring grassland savannas from degraded pinyon-juniper woodlands: effects of mechanical overstory reduction and slash treatment alternatives. *Journal of Environmental Management* 64 (2): 179–197.

Brown, E.J., Stewart, T.J., and Carey, A. 2018. *An Ethnographic Evaluation of the Greater Santa Fe Fireshed.* Santa Fe, New Mexico: U.S. Department of Agriculture, U.S. Forest Service, Santa Fe National Forest.

Brown, G.W., and J.T. Krygier. 1970. Effects of clear-cutting on stream temperature. *Water Resources Research* 6(4):1133-1139.

Brown, P.M., C.L. Wienk, and A.J. Symstad. 2008. Fire and forest history at Mount Rushmore. *Ecological Application* 18(8):1984–1999.

Brown, T.C., and T.C. Daniel. 1984. *Modeling Forest Scenic Beauty: Concepts and Application to Ponderosa Pine*. Research Paper RM-RP-256. U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

———. 1986. Predicting scenic beauty of timber stands. Forest Science 32(2):471-487.

———. 1987. Context effects in perceived environmental quality assessment: Science selection and landscape quality ratings. *Journal of Environmental Psychology* 7:233-250.

Brush, R.O. 1979. The attractiveness of woodlands: Perceptions of forest landowners in Massachusetts. *Forest Science* 25:495-506.

Bunting, S.C., R. Robberecht, and G.E. Defosse. 1998. Length and timing of grazing on postburn productivity of two bunchgrasses in an Idaho experimental range. *International Journal of Wildland Fire* 8(1): 15-20.

Bureau of Land Management (BLM). 2019a. Santa Fe River Greenway Project. Environmental Assessment. Santa Fe County, New Mexico. DOI-BLM-NM-F020-2019-0008-EA. Available at: https://eplanning.blm.gov/epl-front-office/projects/nepa/120934/20008759/250010309/Environmental_Assessment_-_Santa_Fe_River_Greenway_Project.pdf. Accessed 1/20/2020.

Busse, M.D., K.R. Hubbert, and E.E. Moghaddas. 2014. *Fuel Reduction Practices and their Effects on Soil Quality*. General Technical Report PSW-GTR-241. Albany, California: U.S. Department of Agriculture, U.S. Forest Service, Pacific Southwest Research Station.

Campbell, A.J., and J.M. Comstock 2021. Santa Fe Mountains Landscape Resiliency Project: Phase 1 Literature Review. USDA Forest Service Cultural Resources Report 2017-03-10-007D, NMCRIS Activity 145586. Santa Fe, New Mexico: U.S. Department of Agriculture, U.S. Forest Service, Santa Fe National Forest.

Certini, G. 2005. Effects of fire on properties of forest soils: a review. *Oecologia* 143(1):1-10.

City of Santa Fe. n.d. Watershed Project Areas. Available at: https://www.santafenm.gov/media/archive_center/AnticipatedWatershedProjectAreas_CD.pdf. Accessed January 20, 2020.

———. 2017. City of Santa Fe Land Use & Urban Design Plan. Draft. Available at: https://www.santafenm.gov/land_use__urban_design_plan. Accessed January 20, 2020.

Clewell, A., J. Rieger, and J. Munro. 2005. Guidelines for Developing and Managing Ecological Restoration Projects, 2nd ed. Tucson AZ: Society for Ecological Restoration International. Reprinted in Clewell and Aronson 2007. Available at: www.ser.org/content/guidelines_ecological_restoration.asp.

Cohen, J.D. 2000a. Preventing disaster: home ignitability in the wildland-urban interface. *Journal of Forestry* 98(3):15–21.

———. 2000b. A brief summary of my Los Alamos fire destruction examination. *Wildfire* 9(4):16–18.

———. 2001. Wildland-urban fire—a different approach. In: *Proceedings of the Fire-fighter Safety Summit, Nov. 6-8, 2001, Missoula, MT*. Fairfax, Virginia: International Association of Wildland Fire.

———. 2004. Relating flame radiation to home ignition using modeling and experimental crown fires. *Canadian Journal of Forest Research* 34:1616-1626.

Cohen, J.D., and R.D. Stratton. 2003. Home destruction. In *Hayman Fire Case Study*, edited by R.T. Graham, pp. 263–292. General Technical Report RMRS-GTR-114. Ogden, Utah: USDA Forest Service, Rocky Mountain Research Station.

———. 2008. *Home Destruction Examination, Grass Valley Fire, Lake Arrowhead, California*. R5-TP-026b. United States Department of Agriculture.

Coleman, T. 2018. U.S. Department of Agriculture, U.S. Forest Service. Forest Health Protection and State Forestry Organization. Available at: https://www.fs.fed.us/foresthealth/applied-sciences/news/2018/caterpillars.shtml. Accessed June 2020.

Collins, B.M., J.J. Moghaddas, and S.L. Stephens. 2007. Initial changes in forest structure and understory plant communities following fuel reduction activities in a Sierra Nevada mixed conifer forest. *Forest Ecology and Management* 239: 102–111.

Cooper, C.F. 1961. Controlled burning and watershed condition in the White Mountains of Arizona. *Journal of Forestry* 59(6):438–442.

Covington, W.W., L.F. DeBano, and T.G. Huntsberger. 1991. Soil nitrogen changes associated with slash pile burning in pinyon-juniper woodlands. *Forest Science* 37(1): 347-355.

Covington, W.W., and M.M. Moore. 1994. Southwestern ponderosa forest structure and resource 712 conditions: changes since Euro-American settlement. *Journal of Sustainable Forestry* 92(1):9–47.

Covington, W.W., P.Z. Fulé, M.M. Moore, S.C. Hart, T.E. Kolb, J.N. Mast, S.S. Sackett, and M.R. Wagner. 1997. Restoring ecosystem health in ponderosa pine forests of the Southwest. *Journal of Forestry* 95:23–29.

Cram, D., T. Baker, and J. Boren. 2006. *Wildland Fire Effects in Silviculturally Treated vs. Untreated Stands of New Mexico and Arizona.* Research Paper RMRS-RP-55. Fort Collins, Colorado: U.S. Forest Service, Rocky Mountain Research Station.

Curtis, R.O. 1970. Stand density measures: an interpretation. *Forest Science* 16:403-414.

Dahms, C.W., and B.W. Geils. 1997. *An Assessment of Forest Ecosystem Health in the Southwest*. General Technical Report RM-GTR-295. U.S. Forest Service.

Dick-Peddie, W.D. 1993. *New Mexico Vegetation: Past, Present, Future*. Albuquerque: University of New Mexico Press.

Dwire, K.A.; Meyer, K.E.; Riegel, G.; Burton, T. 2016. Riparian fuel treatments in the western USA: Challenges and considerations. General Technical Report RMRS-GTR-352. U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Eidenshink, J., B. Schwind, K. Brewer, Z.L. Zhu, B. Quayle, and S. Howard. 2007. A project for monitoring trends in burn severity. *Fire Ecology* 3:3-21.

Elliott, M.L. 1999.*The Dome Fire Archeology Project of 1996-1997: A Summary Report*. Los Alamos, New Mexico: National Park Service, Bandelier National Monument.

Elliot, W.J., Hall, D.E., Scheele, D. L. 2000. WEPP Interface for Disturbed Forest and Range Runoff, Erosion and Sediment Delivery. U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station and San Dimas Technology and Development Center. February. Available at: https://forest.moscowfsl.wsu.edu/cgi-bin/fswepp/wd/weppdist.pl.

Evenson, W.E., J.D. Brotherson, and R.B. Wilcox. 1980. Relationship between environmental and vegetational parameters for understory and open-area communities. *Great Basin Naturalist* 40:167-174.

Everett, R.; Schellhaas, R.; Ohlson, P.; Spurbeck, D.; Keenum, D. 2003. Continuity in fire disturbance between riparian and adjacent sideslope Douglas-fir forests. *Forest Ecology and Management* 175: 31-47.

Fanariotu, I., and D. Skuras. 2004. The contribution of scenic beauty indicators in estimating environmental welfare measures: A case study. *Social Indicators Research* 65(2):145-165.

Fettig, C.J., K.D. Klepzig, R.F. Billings, A.S. Munson, T.E. Nebeker, J.F. Negron, and J.T. Nowak. 2007. The effectiveness of vegetation management practices for prevention and control of bark beetle infestations in coniferous forests of the western and southern United States. *Forest Ecology and Management* 238(1-3):24–53.

Fierke, M.K., and J.B. Kauffman. 2005. Structural dynamics of riparian forests along a black cottonwood successional gradient. *Forest Ecology and Management* 215:149-162.

Floyd, M.L., D.D. Hanna, and W.H. Romme. 2004. Historical and recent fire regimes in pinon–juniper woodlands on Mesa Verde, Colorado, USA. *Forest Ecology and Management* 198:269–289. doi:10.1016/J.FORECO.2004.04.006.

Friederici, P. (editor). 2003. *Ecological Restoration of Southwestern Ponderosa Pine Forests*. Washington, D.C.: Island Press.

Fulé, P.Z. 2008. Does it make sense to restore wildland fire in changing climate? *Restoration Ecology* 16:526–531.

Gobster, Paul H. 1994. The aesthetic experience of sustainable forest ecosystems. In: Covington, W. Wallace; Debano, Leonard F., tech. coord. Sustainable ecological systems: implementing an ecological approach to land management; 1993 July 12-15; Flagstaff, AZ. General Technical Report RM-247. Fort Collins, CO: U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station: 246-255.

———. 1995. Aldo Leopold’s ecological esthetic: integrating esthetic and biodiversity values. *Journal of Forestry* 93(2): 6-10.

Graham, R.T., S. McCaffrey, and T.B. Jain. 2004. *Science Basis for Changing Forest Structure to Modify Wildfire Behavior and Severity*. Fort Collins, Colorado: USDA Forest Service, Rocky Mountain Research Station.

Greacen, E.L., and r. Sands. 1980. Compaction of forest soils. A review. *Soil Research* 18(2):163-189.

Greater Santa Fe Fireshed Coalition. 2020. Coalition Website. Accessed January 15, 2020. Available at: http://www.santafefireshed.org/.

Griffis, K.L., J.A. Crawford, M.R. Wagner, and W.H. Moir. 2001. Understory response to management treatments in northern Arizona ponderosa pine forests. *Forest Ecology and Management* 146: 239–245.

Gutzler, D.S. 2013. Regional climatic considerations for borderlands sustainability. *Ecosphere* 4(1):7.

Gutzler, D.S., and T.O. Robbins. 2011. Climate variability and projected change in the western United States: regional downscaling and drought statistics. *Climate Dynamics* 37:835–849.

Hadfield, J.S., R.L. Mathiasen, and F.G. Hawksworth. 2000. *Douglas-fir Dwarf Mistletoe*. Forest Insect & Disease Leaflet 54 (revised). Washington, D.C.: USDA Forest Service.

Haider, W., and L. Hunt. 2002. Visual aesthetic quality of Northern Ontario's forested shorelines. New York, NY. *Environmental Management*, Vol. 29, No. 3, pp.324-334.

Hann, W.J., A. Shlisky, D. Havlina, K. Schon, S.W. Barrett, T.E. DeMeo, K. Pohl, J.P. Menakis, D. Hamilton, J. Jones, M. Levesque, and C.K. Frame. 2008. *Interagency Fire Regime Condition Class Guidebook*. Version 1.3.0. Available at: http://npshistory.com/publications/fire/frcc-guidebook-2008.pdf.

Hatchett, B., Hogan, M.P. and Grismer, M.E., 2006. Mechanized mastication effects on soil compaction and runoff from forests in the Western Lake Tahoe Basin. *California Agriculture*, 60(2), pp.77-82.

Helms, J.A. 1998. *The Dictionary of Forestry*. Bethesda, Maryland: The Society of American Foresters.

Hessburg, P. F., J. K. Agee,and J. F. Franklin. 2005. Dry forests and wildland fires of the inland Northwest USA: contrasting the landscape ecology of the pre-settlement and modern eras. *Forest Ecology and Management* **211**: 117– 139.

Hill, D., and T. Daniel. 2008. Foundations for an ecological aesthetic: Can information alter landscape preferences? *Society and Natural Resources* 21:34-49.

Hohner, A.K., Rhoades, C.C., Wilkerson, P. and Rosario-Ortiz, F.L. 2019. Wildfires alter forest watersheds and threaten drinking water quality. *Accounts of Chemical Research*, 52(5), pp.1234-1244.

Hook, A. 2020a. Personal Communication. Email from Alan Hook (Water Resources Analyst, Public Utilities, City of Santa Fe) regarding Manganese in water quality samples within the municipal watershed. February 3, 2020. Included HEAL, 2017 water quality sampling results.

———. 2020b. Personal Communication. Conversation with Alan Hook (Water Resources Analyst, Public Utilities, City of Santa Fe) regarding aquatic biota observations in the municipal watershed and algal blooms in the reservoirs. 2/6/2020.

Horton, J.L., T.E. Kolb, and S.C. Hart. 2001. Responses of riparian trees to interannual variation in ground water depth in a semi-arid river basin. *Plant, Cell, and Environment* 24:293-304.

Hurteau, M.d. 2017. Quantifying the carbon balance of forest restoration and wildfire under projected climate in the fire-prone southwestern US. *PLoS ONE* 12(1):e0169275. Available at: https://doi.org/10.1371/journal.pone.0169275.

Interagency Fuels Treatment Decision Support System (IFTDSS). 2020. Interagency Fuels Treatment Decision Support System [Online]. U.S. Department of Interior, Wildland Fire Management: Research, Development, and Application. Available at: https://iftdss.firenet.gov/landing_page/. Accessed 2019-2020.

Intergovernmental Panel on Climate Change (IPCC). 2021. *Climate Change 2021 The Physical Science Basis.* Available at: https://report.ipcc.ch/ar6/wg1/IPCC_AR6_WGI_FullReport.pdf . Accessed December 2022.

Jirik, S.J., and S.C. Bunting. 1994. Postfire defoliation response of Agropyron spicatum and Sitanion ystrix. *International Journal of Wildland Fire* 4(2): 77-82.

Johansen, K. G. Personal Communication. City of Santa Fe Engineer (Water Engineering Department). 3-23-20.

Kane, J.M., Varner, J.M., Knapp, E.E. and Powers, R.F. 2010. Understory vegetation response to mechanical mastication and other fuels treatments in a ponderosa pine forest. *Applied Vegetation Science*, 13(2):207-220.

Kaufmann, M.R., L.S. Huckaby, C.M. Regan, and J. Popp. 1998. *Forest Reference Conditions for Ecosystem Management in the Sacramento Mountains, New Mexico.* General Technical Report RMRS-GTR-19. Fort Collins, Colorado: U.S. Forest Service, Rocky Mountain Research Station.

Kegley, S. 2011. *Douglas-fir Beetle Management*. USDA Forest Service. Forest Health Protection and State Forestry Organization. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187396.pdf.

King, J., and D. Louw. 1998. Instream flow assessments for regulated rivers in South Africa using the Building Block Methodology. *Aquatic Ecosystem Health & Management* 1:109-124.

Kirkland, J. 2012. *Logging Debris Matters: Better Soil, Fewer Invasive Plants*. U.S. Forest Service. Available at: https://www.fs.fed.us/pnw/sciencef/scifi145.pdf. Accessed April 2020.

LANDFIRE: 2006. LANDFIRE Rapid Assessment potential vegetation, succession, & fire regime products, Riparian Deciduous Woodland (R3RIPAgr). Model files and reports. Available at: www.landfire.gov. USDA Forest Service, U.S. Department of the Interior.

———. 2008. Vegetation Condition Class layer. (2014b, January - last update). U.S. Department of Interior, Geological Survey. [Online]. Available at: http://www.landfire.gov/NationalProductDescriptions10.php. Accessed March 3, 2020.

———. 2010. LANDFIRE 1.1.0 vegetation dynamics models and Biophysical Setting descriptions, North American Warm Desert Riparian Systems (2511550). Model files and reports. Available at: www.landfire.gov. U.S. Department of Agriculture, U.S. Forest Service, U.S. Department of the Interior.

——— 2020. Fire Regimes. Available at: https://www.landfire.gov/fireregime.php. Accessed February 14, 2020.

Larson, A.J., R.T. Belote, C.A. Cansler, S.A. Parks, and M.S. Dietz. 2013. Latent resilience in ponderosa pine forest: effects of resumed frequent fire. *Ecological Applications*. Volume 23, Issue 6. Available at: https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/13-0066.1. Accessed 5/1/2020.

Laughlin, D.C., J.D. Bakker, M.L. Daniels, M.M. Moore, C.A. Casey, and J.D. Springer. 2008. Restoring plant species diversity and community composition in a ponderosa pine–bunchgrass ecosystem. *Plant Ecology* 197: 139–151.

Lentz, S.C., Gaunt, J.K., and Willmer, A.J. 1996. Fire Effects on Archaeological Resources, Phase 1: The Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico. U.S. Department of Agriculture, U.S. Forest Service, Rock Mountain Forest and Range Experimental Station. Ft. Collins, CO.

Lewis, A.C., 2018. Monitoring Effects of Wildfire Mitigation Treatments on Water Budget Components: A Paired Basin Study in the Santa Fe Watershed, New Mexico. New Mexico Bureau of Geology and Mineral Resources.

Lissoway, J. and J. Propper. 1990. Effects of fire on cultural resources. In Krammes, J.S. (ed.). Effects of fire management of Southwestern natural resources: Proceedings of the Symposium, November 15-18, 1988, Tucson, AZ. Pp. 1-10. General Technical Report RM-GTR-191. Fort Collins, CO: U.S. Department of Agriculture, U.S. Forest Service Rocky Mountain Research Station.

Livingston, L. 2010. *Management Guide for Pine Engraver*. USDA Forest Service, Forest Health Protection and State Forestry Organization. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187526.pdf.

Llewellyn, D., and S. Vaddey. 2013. *West-Wide Climate Risk Assessment: Upper Rio Grande Impact Assessment*. U.S. Bureau of Reclamation, Albuquerque Area Office, Upper Colorado Region. Available at: http://www.usbr.gov/WaterSMART/wcra/docs/urgia/URGIAMainReport.pdf.

Lolley, M.R., C. McNicoll, J. Encinas, J. Monzingo, C. Koury, G. Partido, M. Levesque, A. Bradley, and P. McCarthy. 2006. Restoring the Functionality of Fire Adapted Ecosystems, Gila National Forest, Restoration Need and Opportunity. Unpublished report. Gila National Forest, New Mexico.

Long, J.N. 1985. A practical approach to density management, For. Cbron. 61(1):23-27.

Lynch, J.A., Rishel, G.B. and Corbett, E.S., 1984. Thermal alteration of streams draining clear-cut watersheds: quantification and biological implications. *Hydrobiologia* 111(3):161-169.

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.

Margolis, E.Q., D.W. Huffman, and J.M. Iniguez. 2013. *Southwestern Mixed-Conifer Forests: Evaluating Reference Conditions to Guide Ecological Restoration Treatments*. Ecological Restoration Institute Working Paper No. 28. Flagstaff: Northern Arizona University.

Margolis, E.Q., T.W. Swetnam, and C.D. Allen. 2007. A stand-replacing fire history in upper montane forests of the southern Rocky Mountains. *Canadian Journal of Forest Research* 37:2227–2241.

Meigs, G.W., D.C. Donato, J.L. Campbell, J.G. Martin, B.E. Law. 2009. Forest fire impacts on carbon uptake, storage, and emission: the role of burn severity in the eastern Cascades, Oregon. *Ecosystems*12: 1246-1267.

Meixner, T. and Wohlgemuth, P., 2004. Wildfire impacts on water quality. *Journal of Wildland Fire*, 13(1), pp.27-35.

Miller, J.R., T.T. Schulz, N.T. Hobbs, K.R. Wilson, D.L. Schrupp, and W.L. Baker. 1995. Changes in the landscape structure of a southeastern Wyoming riparian zone following shifts in stream dynamics. *Biological Conservation* 72:371-379.

Moore, M.M., W.W. Covington, and P.Z. Fulé. 1999. Evolutionary environment, reference conditions, and ecological restoration: a southwestern ponderosa pine perspective. *Ecological Applications* 9: 1266-1277.

Moore, M. M., Huffman, D. W., Fulé, P. Z., Covington, W. W., & Crouse, J. E. 2004. Comparison of Historical and Contemporary Forest Structure and Composition on Permanent Plots in Southwestern Ponderosa Pine Forests. *Forest Science*, 50(2), 163-176.

Nader, G., Z. Henkin, E. Smith, R. Ingram, N. Narvaez. 2007. Planned Herbivory in the Management of Wildfire Fuels. *Rangelands* 29: 18-24

National Park Service. 2010. *Species Fact Sheet Family Strigidae (True Owls): Mexican Spotted Owl (Strix occidentalis lucinda).* Available at: https://irma.nps.gov/DataStore/DownloadFile/499019. Accessed August 2021.

———. 2020. Class I Areas. Available at: https://www.nps.gov/subjects/air/class1.htm. Accessed June 24, 2021.

National Wildfire Coordinating Group (NWCG). 2016. Class 1 Areas and Regional Hazel. Available at: https://www.frames.gov/smoke/tutorial/module-2/regional-haze. Accessed June 24, 2021.

———. 2017. *Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations*. Available at: https://www.nwcg.gov/publications/444. Accessed January 27, 2020.

———. 2018. *Smoke Management Guide for Prescribed Fire*. NFES 001279. PMS 420-2. National Wildfire Coordinating Group.

———. 2020. Wildland Fire Decision Support System (WFDSS): wildland fire occurrence history database [Online]. Boise, Idaho. Available at: https://wfdss.usgs.gov/wfdss/WFDSS_Home.shtml. Accessed January 30, 2020.

Neary, D.G., Gottfried, G.J. and Folliott, P.F., 2003, November. Post-wildfire watershed flood responses. In Proceedings of the 2nd International Fire Ecology Conference, Orlando, Florida (pp. 16-20).

New Mexico Environment Department. 2017. *EPA Approved Total Maximum Daily Load (TMDL) for Galisteo Creek*. Santa Fe: New Mexico Environment Department.

———. 2020. Regional Haze Planning. New Mexico Environment Department, Air Quality Bureau. Available at: https://www.env.nm.gov/air-quality/reg-haze/. Accessed February 26, 2020.

New Mexico Energy, Minerals and Natural Resources Department, Forestry Division. 2020. 2020 New Mexico Forest Action Plan: A Collaborative Approach to Landscape Resilience. New Mexico Energy, Minerals and Natural Resources Department, Forestry Division. Santa Fe, NM.

Oster, E.A., Ruscavage-Barz, S., and Elliott, M.L. 2012. The Effects of Fire on Subsurface Archeological Materials. In *Wildland Fire in Ecosystems: Effects of Fire on Cultural Resources and Archeology*. K.C. Ryan, A.T. Jones, C.L. Koerner, and K.M. Lee, eds. U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station. Ft. Collins, CO. Pp. 143-156.

Pederson, L., N. Sturdevant, and D. Blackford. 2011. Western Spruce Budworm Management. Chapter 6.1 in *Forest Insect and Disease Management Guide for the Northern and Central Rocky Mountains*. USDA Forest Service, Northern Region, State and Private Forestry. Available at: https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5186684.pdf.

Peterson, D.L., M.C. Johnson, J.K. Agee, T.B. Jain, D. McKenzie, and E.D. Reinhardt. 2005. *Forest Structure and Fire Hazard in Dry Forests of the Western United States*. General Technical Report PNW-GTR-628. United States Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Pilliod, D.S., E.L. Bull, J.L. Hayes, and B.C. Wales. 2006. *Wildlife and Invertebrate Response to Fuel Reduction Treatments in Dry Coniferous Forests of the Western United States: A Synthesis*. General Technical Report RMRS-GTR-173. Fort Collins, Colorado: U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station.

Powell, D.C. 2012. *A Stage Is A Stage Is A Stage…Or Is It? Successional Stages, Structural Stages, Seral Stages*. White Paper F14-SO-WP-Silv-10. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5413728.pdf. Accessed August 30, 2021.

Prichard, D.; Barrett, H.; Cagney, J.; Clark, R.; Fogg, J.; Gebhart, K.; Hansen, P.L.; Mitchell, B.; Tippy, D. 1998. Riparian area management: A user guide to assessing Proper Functioning Condition and supporting science for lotic areas. USDI Bureau of Land Management Technical guide TR 1737-15. BLM Service Center, CO. 126 pp.

Puglisi, A. 2020. Personal Communication. City of Santa Fe Environmental Compliance Specialist.

Raish, C.B., and A.M. McSweeny. 2003. *Economic, Social, and Cultural Aspects of Livestock Ranching on the Espanola and Canjilon Ranger Districts of the Santa Fe and Carson National Forests: A Pilot Study.* General Technical Report RMRS-GTR-113. Fort Collins, CO: U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station.

———. 2012. *Social, Cultural, and Economic Aspects of Livestock Ranching on the Santa Fe and Carson National Forests*. General Technical Report RMRS-GTR-276. Fort Collins, CO: U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station.

Randall, C.B. 2010a. *Management Guide for Western Pine Beetle*. USDA Forest Service, Forest Health Protection and State Forestry Organization. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5188577.pdf.

———. 2010b. *Management Guide for Douglas-fir Tussock Moth*. USDA Forest Service, Forest Health Protection and State Forestry Organization. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187412.pdf.

———. 2012. *Management Guide for Fir Engraver*. USDA Forest Service, Forest Health Projection and State Forestry Organization. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187436.pdf.

Reynolds, R.T., A.J. Sánchez Meador, J. Andrew, 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 Science-Based Framework for Improving Ecosystem Resiliency*. General Technical Report RMRS-GTR-310. Fort Collins, Colorado: U.S. Forest Service, Rocky Mountain Research Station.

Rhoades, C.C., Chow, A.T., Covino, T.P., Fegel, T.S., Pierson, D.N. and Rhea, A.E., 2019. The legacy of a severe wildfire on stream nitrogen and carbon in headwater catchments. *Ecosystems*, 22(3), pp.643-657.

Rhoades, C.C., Entwistle, D. and Butler, D., 2011. The influence of wildfire extent and severity on stream-water chemistry, sediment and temperature following the Hayman Fire, Colorado. *International Journal of Wildland Fire* 20(3):430-442.

Ribe, R.G. 1990. A general model for understanding the perception of scenic beauty in northern hardwood forests. Madison, WI. *Landscape Journal* 9:86–101.

Robichaud, P.R., 2000. Fire effects on infiltration rates after prescribed fire in Northern Rocky Mountain forests, USA. *Journal of Hydrology* 231:220-229.

Romme, W.H., C.D. Allen, J.D. Bailey, W.L. Baker, B.T. Bestelmeyer, P.M. Brown, K.S. Eisenhart, M.L. Floyd, D.W. Huffman, B.F. Jacobs, and R.F. Miller. 2009. Historical and modern disturbance regimes, stand structures, and landscape dynamics in piñon–juniper vegetation of the western United States. *Rangeland Ecology and Management* 62(3):203–222. Available at: https://arizona.pure.elsevier.com/en/publications/historical-and-modern-disturbance-regimes-stand-structures-and-la. Accessed June 2018.

Ryan, K.C., A.T. Jones, C.L. Koerner, K.M. Lee (eds.). 2012. *Wildfire in Ecosystems: Effects of Fire on Cultural Resources and Archaeology*. Ft. Collins, Colorado: U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station.

Ryan, Robert L. 2005. *Social Science to Improve Fuels Management: A Synthesis of Research on Aesthetics and Fuels Management.* General Technical Report NC-261. St. Paul, MN: U.S. Department of Agriculture, U.S. Forest Service, North Central Research Station.

Sackett, Stephen S., and Sally M. Haase. 1998. Two case histories for using prescribed fire to restore ponderosa pine ecosystems in northern Arizona. Pages 380-389 in Teresa L. Pruden and Leonard A. Brennan (eds.). *Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescription.* Tall Timbers Fire Ecology Conference Proceedings, No. 20. Tallahassee, Florida: Tall Timbers Research Station.

Schwandt, J., H. Kearns, and J. Byler. 2013. *White Pine Blister Rust General Ecology and Management*. USDA Forest Service, Forest Health Protection and State Forestry Organization. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5415080.pdf.

Seager, R., M. Ting, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H. Huang, N. Harnik, A. Leetmaa, N. Lau, C. Li, J. Velez, and N. Naik. 2008. Model projections of an imminent transition to a more arid climate in southwestern North America. *Science* 316:1181–1184.

Shephard, Z. and Cadol, D. 2018. Prescribed Fire Treatment Surface Water Quality Monitoring: Study Summary and Final Report, Santa Fe Municipal Watershed, Santa Fe NM. Final Report, Revision 1. December 27, 2018. New Mexico Institute of Mining and Technology. Unpublished.

Singleton, M., A. Thode, A. Sanchez Meador, and P. Iniguez. 2019. Increasing trends in high-severity fire in the southwestern USA from 1984-2015. *Forest Ecology and Management*.

Skinner, C.N. 2003. A tree-ring based fire history of riparian reserves in the Klamath Mountains. In: P.M Faber (ed.) Proceedings, California riparian systems: Processes and floodplains management, ecology, and restoration, 12-15 March 2001, Sacramento, CA. Riparian Habitat Joint Venture: 116–119.

Smith, D.M., K.P. Driscoll, and D.M. Finch. 2018. *Riparian and Wetland Ecosystems of the Ashley National Forest: An Assessment of Current Conditions in Relation to Natural Range of Variation*. General Technical Report RMRS-GTR-378. Fort Collins, Colorado: USDA Forest Service, Rocky Mountain Research Station.

Spencer, C.N., Gabel, K.O. and Hauer, F.R. 2003. Wildfire effects on stream food webs and nutrient dynamics in Glacier National Park, USA. Forest Ecology and Management, 178(1-2), pp.141-153.

Squires, J.R. and R.T. Reynolds. 1997. In: Poole, A.; Gill, F. eds. *The Birds of North America*, No. 298. Washington, D.C.: The Academy of Natural Sciences Philadelphia, PA; The American Ornithologists' Union. p. 1-31.

Stahlecker, D.W., and H.A. Walker. 2010. Bald Eagle. In *The Raptors of New Mexico*, edited by J.-L. Cartron. Albuquerque: University of New Mexico Press.

Stanford, J.A., M.S. Lorang, and F.R. Hauer. 2005. The shifting habitat mosaic of river ecosystems. *Verhandlungen Des International Verein Limnologie* 29:123-136.

Santa Fe County, September 2020 – Santa Fe County Wildfire Protection Plan. Available at: https://www.santafecountynm.gov/media/files/CWPP Online Version with signatures.pdf

Stednick, John D. 2010. Effects of fuel management practices on water quality. In: Elliot, William J.; Miller, Ina Sue; Audin, Lisa, eds. *Cumulative Watershed Effects of Fuel Management in the Western United States*. General Technical Report RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station. p. 149-163.

Stephens, S.L., Meixner, T., Poth, M., McGurk, B. and Payne, D. 2004. Prescribed fire, soils, and stream water chemistry in a watershed in the Lake Tahoe Basin, California. *International Journal of Wildland Fire*, 13(1):27-35.

Stromberg, J.C., J. Fry, and D.T. Patten. 1997. Marsh development after large floods in an alluvial, arid-land river. *Wetlands* 17:292-300.

Stromberg, J., and E. Ortiz-Zuazaga. 1998. *Fire Effects on Riparian Communities of the San Pedro Basin and Associated Species of Concern*. Tucson, Arizona: The Nature Conservancy, Arizona Chapter.

SWCA Environmental Consultants (SWCA). 2020. *Santa Fe Community Wildfire Protection Plan*. Available at: https://www.santafecountynm.gov/fire/wildland. Accessed August 2020.

Swetnam, T., and C. Baisan. 1996. Historical fire regime patterns in the southwestern United States since AD 1700. In: CD Allen (ed) *Fire Effects in Southwestern Forest: Proceedings of the 2nd La Mesa Fire Symposium*, pp. 11-32. U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station, General Technical Report RM-GTR-286.

Taylor, A.H., and C.N. Skinner. 2003. Spatial patterns and controls on historical fire regimes and forest structure in the Klamath Mountains. *Ecological Applications* 13:704–719.

Taylor, J.G., and T.C. Daniel. 1984. Prescribed fire: public education and perception. *Journal of Forestry* 82:361-365.

Triepke, F.J., B.J. Higgins, R. N. Weisz, J.A. Youtz, and T. Nicolet. 2011. *Diameter Caps and Forest Restoration — Evaluation of a 16-inch cut limit on achieving desired conditions*. U.S. Department of Agriculture, U.S. Forest Service Forestry Report FR-R3-16-3. Albuquerque, New Mexico: Southwestern Region, Regional Office.

Triepke, F.J., E.H. Muldavin, and M.M. Wahlberg. 2019. Using climate projections to assess ecosystem vulnerability at scales relevant to managers. *Ecosphere* 10(9):p.e02854.

Triepke, F.J., M.M. Wahlberg, D.C. Cress, and R.L. Benton. 2018. RMAP – Regional Riparian Mapping Project. Available at: http://www.fs.usda.gov/main/r3/landmanagement/gis. Albuquerque, New Mexico: U.S. Department of Agriculture, U.S. Forest Service, Southwestern Region.

Ulev, E.D. 2006. *Gymnorhinus cyanocephalus*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available at: www.fs.fed.us/database/feis/animals/bird/gycy/all.html [2021, August 15].

U.S. Climate Resilience Toolkit. 2020. The Climate Explorer. Available at: https://toolkit.climate.gov/#climate-explorer. Accessed February 12, 2012.

U.S. Department of Agriculture (USDA). 1989. Forage quality in burned and unburned aspen communities. Research Paper RP-INT-404. Ogden, Utah: Intermountain Research Station.

———. 2011. *Watershed Condition Classification Technical Guide*. United States Department of Agriculture. U.S. Forest Service. FS-978. July 2011.

———. 2015a. *Baseline Estimates of Carbon Stocks in Forests and Harvested Wood Products for National Forest System Units*. (Two baselines: 1990-2013, 2005-2013). Southwestern Region Climate Change Advisor's Office, Office of the Chief. USDA Forest Service.

———. 2015b. Phos-Chek Fire Retardants for Use in Preventing and Controlling Fires in Wildland Fuels. Frequently Asked Questions. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3851594.pdf.

———. 2016. *Hydrologic Analyses of Post-Wildfire Conditions*. Natural Resources Conservation Service. Title 210, Hydrology Technical Note No. 4.

———. 2018. A Wetness Index Model. Unpublished. Modeled by Bill Overland, U.S. Forest Service Enterprise Program Hydrologist, February 2020.

U.S. Department of Health and Human Services. 2012. Public Health Service. Agency for Toxic Substances and Disease Registry. Toxilogical Profile for Manganese. Atlanta, Georgia. September. Available at: https://www.atsdr.cdc.gov/toxprofiles/tp151.pdf.

U.S. Environmental Protection Agency (EPA). 2020a. Location of EPA certified air quality monitoring locations in northern New Mexico. USEPA, Washington DC. Website Accessed February 23, 2020: https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=5f239fd3e72f424f98ef3d5def547eb5&extent=-146.2334,13.1913,-46.3896,56.5319

———. 2020b. 2014 National Emissions Inventory (NEI) Data. Washington, D.C. Available at: https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data. Accessed February 27, 2020.

U.S. Fish and Wildlife Service (USFWS). 1994. Endangered and threatened wildlife and plants: Determination of endangered status for the plant *Ipomopsis sancti-spiritus* (Holy Ghost ipomopsis). *Federal Register* 59:13836-13841.

———. 2002. *Holy Ghost Ipomopsis (*Ipomopsis sancti-spiritus*) Recovery Plan*. Albuquerque, New Mexico: U.S. Fish and Wildlife Service.

———. 2012. *Final Recovery Plan for the Mexican Spotted Owl (*Strix occidentalis lucida*), First Revision*. Albuquerque, New Mexico: U.S. Fish and Wildlife Service, Region 2. Final approval date November 2012.

U.S. Forest Service. 1974. *National Forest Landscape Management Vol. 2: Chapter 1 The Visual Management System*. Agriculture Handbook 462.

———. 1986. *Recreation Opportunity Spectrum Field Guide*. Available at: http://www.fs.fed.us/cdt/carrying_capacity/rosfieldguide/ros_primer_and_field_guide.htm. Accessed April 30, 2020.

———. 1992. *Management Recommendations for the Northern Goshawk in the Southwestern United States*. General Technical Report RM-217. U.S. Department of Agriculture, Rocky Mountain Forest and Range Experiment Station. Available at: https://www.fs.fed.us/rm/pubs_rm/rm_gtr217.pdf. Accessed April 7, 2020.

———. 1993. Terrestrial ecosystem survey of the Santa Fe National Forest. Technical report on file. Albuquerque, New Mexico: Southwestern Region.

———. 1995. *Landscape Aesthetics: A Handbook for Scenery Management*. Agriculture Handbook 701.

———. 2001. Roadless Area Final Rule. Available at: https://www.fs.fed.us/emc/nepa/roadless/2001RoadlessRuleFR.pdf.

———. 2010a. Appendix J: Standard Consultation Protocol for Large Scale Fuels Reduction, Vegetation Treatments and Habitat Improvement Projects of the *First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities among New Mexico Historic Preservation Officer and Arizona Historic Preservation Officer and Texas and Oklahoma and the Advisory Council on Historic Preservation and the United States Department of Agriculture Forest Service Region 3*. Southwestern Region, Albuquerque, NM. Pp 77-90.

———. 2010b. *First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities Among New Mexico Historic Preservation Officer and Arizona State Historic Preservation Officer, Oklahoma State Historic Preservation Officer, Texas State Historic Preservation Officer, and The Advisory Council on Historic Preservation and United States Department of Agriculture Forest Service Region 3*. Albuquerque, New Mexico: USDA Forest Service, Southwestern Region (Region 3).

———. 2018. *Chief's Review Process for Activities in Roadless Areas*. Washington, D.C.

———. 2013. *Restoring Composition and Structure in Southwestern Frequent-Fire Forests: A Science-based Framework For Improving Ecosystem Resiliency Santa Fe National Forest*. General Technical Report RMRS-GTR-310. Southwestern Region. Rocky Mountain Research Station.

———. 2014. *Desired Conditions for Use in Forest Plan Revision in the Southwestern Region: Development and Science Basis: Final*. Albuquerque, New Mexico: U.S. Department of Agriculture, U.S. Forest Service, Southwest Regional Office.

———. 2015a. *Ecological Response Units of the Southwestern United States*. DRAFT 2014 Forestry Report FR-R3-XX-XX. U.S. Department of Agriculture, U.S. Forest Service, Southwestern Region.

———. 2015b. *Climate Change Vulnerability Assessment for the Santa Fe National Forest*. USDA Forest Service, Southwestern Region.

———. 2016. *Santa Fe National Forest Plan Final Assessment Report - Volume I: Ecological Resources*. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd506133.pdf. Santa Fe, New Mexico: Santa Fe National Forest Supervisor's Office.

———. 2019. *Santa Fe Mountains Landscape Resiliency Project: Scoping Document*. Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. July 10, 2019. Available at: https://www.fs.usda.gov/project/?project=55088. Accessed August 2019.

———. 2020a. *Santa Fe Mountains Landscape Resiliency Project: Vegetation Effects Analysis*. Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. Revised 2022.

———. 2020b. *Santa Fe Mountains Landscape Resiliency Project: Mexican Spotted Owl Nest/Roost Habitat Delineation Process*. December 1, 2020. Revised 2022.

———. 2021a. *Santa Fe Mountains Landscape Resiliency Project: Watershed Resources Effects Analysis.* Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. January 19, 2021. Revised 2022.

———. 2021c. *Santa Fe Mountains Landscape Resiliency Project: Tribal Consultation and Traditional Cultural Uses Specialist Report*. R2017-03-10-007E. Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. April 9, 2021. Revised 2022.

———. 2021d. Selected GIS Databases for the Southwest Region. Available at: https://www.fs.usda.gov/detailfull/r3/landmanagement/gis/?cid=stelprdb5201889&width=full. Accessed August 9, 2021.

———. 2021e. *Santa Fe Mountains Landscape Resiliency Project: Fuels and Wildfire Behavior – Air Quality – Climate Change and Carbon Sequestration*. Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. June 28, 2021. Revised 2022.

———. 2021f. *Draft Mexican Spotted Owl Habitat Project Checklist*. USDA Forest Service, Southwest Region. July.

———. 2021g. *Santa Fe Mountains Landscape Resiliency Project: Riparian Vegetation Effects Analysis*. Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. April 14, 2020. Revised 2022.

———. 2021h. *Santa Fe Mountains Landscape Resiliency Project: Recreation Effects Analysis*. Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. June 29, 2021. Revised 2022.

———. 2021i. *Santa Fe Mountains Landscape Resiliency Project: Scenic Effects Analysis*. Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. February 27, 2020. Revised 2022.

———. 2021j. *Santa Fe Mountains Landscape Resiliency Project: Cultural Resources Specialist Report*. R2017-03-10-007E. Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. April 9, 2021. Revised 2022.

———. 2021k. *Santa Fe Mountains Landscape Resiliency Project: Rangeland Resources Effects Analysis*. Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. February 12, 2021. Revised 2022.

———. 2021l. *Santa Fe Mountains Landscape Resiliency Project: Inventoried Roadless Areas Effects Analysis*. Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. February 12, 2021. Revised 2022.

———. n.d. Projects. Santa Fe National Forest. Available at: https://www.fs.usda.gov/projects/santafe/landmanagement/projects . Accessed 11/16/2022.

———. 2022a. *Santa Fe National Forest Land Management Plan Final Environmental Impact Statement for Rio Arriba, San Miguel, Sandoval, Santa Fe, Mora, and Los Alamos Counties, New Mexico*. MB-R3-10-29. July 2022. U.S. Department of Agriculture, U.S. Forest Service, Southwestern Region.

———. 2022b. *Santa Fe National Forest Land Management Plan Rio Arriba, San Miguel, Sandoval, Santa Fe, Mora, and Los Alamos Counties, New Mexico*. MB-R3-10-28. July 2022 U.S. Department of Agriculture, Forest Service, Southwestern Region.

———. 2022c. *Biological Assessment for the Santa Fe Mountains Landscape Resiliency Project.* Prepared for U.S. Department of Agriculture, U.S. Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. February 1, 2022.

———. 2022d. *2001 Roadless Area Conservation Rule Analysis Santa Fe Mountains Landscape Resiliency Project.* Prepared by U.S. Department of Agriculture, U.S. Forest Service, Santa Fe National Forest. May 11, 2022.

U.S. Geological Survey (USGS). 2019. National Water Information System: Web interface. Available at: waterdata.usgs.gov/nwis. Accessed October 2020.

U.S. Water Resources Policy Commission. 1951. *Ten Rivers in America's Future- The Rio Grande (No. 4). The Report of the President's Water Resources Policy Commission*. Volume 2. U.S. Government Printing Office.

Vegh, T., C. Huang, and A. Finkral. 2013. Carbon credit possibilities and economic implications of fuel reduction treatments. *Western Journal of Applied Forestry* 28(2):57–65.

Webb, R.H., J.W. Steiger, and H.G. Wilshire. 1986. Recovery of compacted soils in Mojave Desert ghost towns. *Soil Science Society of America Journal* 50(5):1341-1344.

Webster, K.M., and C.B. Halpern. 2010. Long-term vegetation responses to reintroduction and repeated use of fire in mixed-conifer forests of the Sierra Nevada. *Ecosphere* 1(5): Article 9.

Wells, B.H. 1918. *Manganese in New Mexico*. Bulletin of the New Mexico State School of Mines. Bulletin No. 2. Mineral Resources Survey. Socorro, NM.

Western Regional Climate Center. 2020. Remote Automatic Weather Station Data [Online]. Reno, Nevada. Available at: https://wrcc.dri.edu/wraws/ncaF.html. Accessed February 22, 2020.

Wiedinmyer, C., and M.D. Hurteau. 2010. *Prescribed Fire As a Means of Reducing Forest Carbon Emissions in the Western United States*. National Wright, H.A., and A.W. Bailey. 1982. Fire ecology: United States and southern Canada. New York, New York: John Wiley and Sons, Inc.

Worrall, J. 2015. *Dwarf Mistletoes: Ecology and Management in the Rocky Mountain Region*. USDA Forest Service, Rocky Mountain Region. Forest Health Management. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd525105.pdf.

Wu, T., and K. Yeon-Su. 2013. Pricing ecosystem resilience in frequent-fire ponderosa pine forests. *Forest Policy and Economics* 27(C):8–12.

Zouhar, K., J.K. Smith, S. Sutherland, and M.L. Brooks. 2008. *Wildland Fire in Ecosystems: Fire and Nonnative Invasive Plants.* General Technical Report RMRS-GTR-42-volume 6. Ogden, Utah: U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Research Station.

Chapter 6. Glossary

Adaptive management: an implementation tool that goes beyond the “predict-mitigate-implement” model and incorporates an “implement-monitor-adapt” strategy that provides flexibility to account for inaccurate initial assumptions, to adapt to changes in environmental conditions or to respond to subsequent monitoring information that indicates that desired conditions are not being met.

Age class: a distinct aggregation (grouping) of trees originating from a single natural event or regeneration activity commonly consisting of trees of similar age.

Aspect: the direction in which a slope faces.

Basal area: the area of a cross-section of a tree, including bark, at breast height (4.5 feet above ground level). Basal area of a forest stand is the sum of the basal areas of all individual trees in the stand, usually given as square feet per acre or square meters per hectare. It is a measurement of how much of a site is occupied by trees.

Biodiversity: the variety, distribution, and abundance of living organisms in an ecosystem. Maintaining biodiversity is believed to promote stability, sustainability, and resilience of ecosystems.

Biomass: the wood product obtained (usually) from in-the-forest chipping of all or some portion of trees including limbs, tops, and unmerchantable stems, usually for energy production.

Broadcast burn: a type of prescribed fire where the burn is intentionally lit so that the fire will spread across the surface of the landscape, sometimes under residual trees, to meet resource objectives.

Browse: woody vegetation that animals use for food.

Brush: usually refers to shrubs and similar low-growing vegetation.

Buffer: an area of specified width where certain activities may not occur. Buffers are usually defined around special sensitive resources such as rare plants or archaeological sites, or along each side of a stream, or near other features to be protected from human disturbance.

Burn severity: a qualitative assessment of the heat pulse directed toward the ground during a fire. Burn severity relates to soil heating, large fuel and duff consumption, consumption of the litter and organic layer beneath trees and isolated shrubs, and mortality of buried plant parts.

Canopy: the more or less continuous cover of leaves and branches in a forest, usually formed by the crowns of the dominant and co-dominant trees.

Canopy base height: the vertical distance from the lowest live branch or whorl on a tree to the ground.

Canopy bulk density: the measure of the density of available canopy fuels, which reflects the likelihood that fire can move through the forest canopy.

Canopy cover or closure (%): Canopy closure and canopy cover are two slightly different measures of the forest canopy that determine the amount of light able to penetrate to the forest floor. Canopy cover is the percentage of a given ground area that is covered by the vertical projection of the crowns of trees. Canopy or crown closure is an integrated measure from multiple angles of the canopy over a segment of the sky (hemisphere) above a single point on the ground. Both estimate the amount that tree canopies interlock and cover the ground surface with shade.

Closed: indicates canopy cover greater than 30%.

Open: indicates canopy cover ranging from 10% to 30%.

CCF: abbreviation signifying 100 cubic feet of wood volume.

Characteristic landscape: description of the aesthetic, social, and biophysical attributes that give a place its identity.

Class I areas (Air Quality): geographic areas designed by the Clean Air Act subject to the most stringent restrictions on allowable increment of air quality deterioration. Class I areas include U.S. Forest Service wildernesses and nation memorial parks over 5,000 acres, National Parks exceeding 6,000 acres, international parks, as well as other designated lands.

Closed road: a road placed in storage between intermittent uses. A closed road is closed to all vehicular traffic but may be available and suitable for nonmotorized uses. A closed road may be opened again for use at some time in the future.

Clump: a tight cluster of two to five trees of similar age and size originating from a common rooting zone that typically lean away from each other when mature. A clump is relatively isolated from other clumps or trees within a group of trees. A stand-alone clump of trees can function as a tree group.

Co-dominant tree: a tree with its crown in the upper level of the canopy of surrounding trees and receiving direct sunlight from above and comparatively little sunlight from the sides.

Community: an assemblage of plant or animal species, dependent on each other, and constituting an organized system or population.

Competition: the process in which organisms with similar requirements contend for resources—light, water, nutrients, and space—that are in limited supply.

Conifer: any tree that produces seeds in cones, with no fruit structure around the seed. Leaves are usually needles, scales, or narrow and linear in shape, and evergreen.

Cover (wildlife): the protective element within an animal's habitat, which provides concealment from predators (hiding cover) and shelter from the weather (thermal cover). Cover takes many forms, including patches of dense brush, tall grasses, the forest canopy, or other landscape features.

Cover type: refers to a forest or woodland type, such as ponderosa pine, pine-oak, or mixed-conifer.

Criteria for treatment selection refers to current site conditions that are considered for treatment.

Critical habitat: refers to specific geographic areas that are essential for the conservation of a federally listed threatened or endangered species and that may require special management and protection.

Crown: the portion of an individual tree above the main stem, consisting of live branches and foliage.

Crown cover: the ground area covered by the crown of a tree as delimited by the vertical projection of its outermost perimeter.

Crown fire (crowning): a fire that burns and moves through the uppermost branches (crowns) of trees and spreads from crown to crown. Fire burning in the crowns of trees is an indicator of a high-intensity wildfire.

Crowning index: the minimum wind speed (an index of rate of spread) required to maintain crown fire activity.

Design feature: a list of management actions designed to guide implementation of on-the-ground activities to achieve desired conditions while minimizing adverse effects. Design features guide proper application of forestry operations, designed primarily to prevent soil erosion and water pollution, and to protect certain wildlife habitat values in riparian and wetland areas.

Desired condition: a portrayal of the land and resource conditions that are expected to result if goals and objectives are fully achieved. These conditions may currently exist or may be achieved sometime in the future. Desired conditions may be based on ecological or social objectives, or both. Desired ecological conditions are typically based upon the concepts of ecosystem structural and functional sustainability, resilience, and adaptive capability.

Diameter at breast height (dbh): a standard measure of tree diameter measured approximately 1.5 meters (4.5 feet) above the ground.

Disturbance: any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment, such as a wildfire, windstorm, insect or disease attack, or flooding.

Drought: a period of relatively long duration with substantially below-normal precipitation, usually occurring over a large area.

Duff: the layer of decomposing organic materials lying below the litter layer of the freshly fallen twigs, needles, and leaves, and above the mineral soil.

Ecological management unit (EMU): Mexican spotted owl management areas that are geographical subdivisions of the owl's range to organize recovery efforts based on natural variability in owl habitat, human influences, international boundaries, and the logistics of implementing the Mexican spotted owl Recovery Plan.

Ecological response unit: technical groupings of finer vegetation classes with similar site potential and disturbance history.

Ecological restoration: the process of assisting the recovery of resilience and adaptive capacity of ecosystems that have been degraded, damaged, or destroyed. Restoration focuses on establishing the composition, structure, pattern, and ecological processes necessary to make terrestrial and aquatic ecosystems sustainable, resilient, and healthy under current and future.

Ecosystem: a complex of interacting organisms (plants, animals, fungi, bacteria, etc.) together with its environment, considered as a unit.

Encroachment: expansion of coniferous forests into meadows or aspen stands due to fire exclusion, grazing, climate change, or other disturbance or management practice that disrupts natural succession processes.

Endangered: a species in danger of extinction throughout all or a significant portion of its range.

Ephemeral waterbody: a stream that flows only briefly during and following a period of rainfall in the immediate vicinity.

Erosion: the wearing away of the land surface by rain or irrigation water, wind, ice, or other natural or anthropogenic agents that abrade, detach, and remove geologic parent material or soil from one point on the earth’s surface and deposit it elsewhere.

Even-aged stand: a stand of trees composed of a single age class in which the range of tree ages is usually about 20% of rotation age.

Extreme fire behavior: extreme implies a level of fire behavior characteristics that ordinarily precludes methods of direct control action. One or more of the following is usually involved: high rate of spread, prolific crowning and/or spotting, presence of fire whirls, strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.

Felling: the cutting of standing trees.

Fine fuels: fast-drying fuels usually less than 0.25 inch in diameter and having a time lag of 1 hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

Fire-adapted ecosystem: an associated group of plant and animals that have made long-term genetic changes in response to the presence of fire in their environment.

Fire behavior: the manner in which a fire reacts to the influences of fuel, weather, and topography.

Fire frequency: a general term referring to the recurrence of fire in a given area over time.

Fire intensity: a term related to the heat energy released during a fire.

Fireline: a linear fire barrier that is scraped or dug to mineral soil that is used to stop or control the spread of fires.

Fire Management Plan: a plan that identifies and integrates all wildland fire management and related activities within the context of approved land/resource management plans. A Fire Management Plan defines a program to manage wildland fires (wildfire and prescribed fire). The plan is supplemented by operational plans, including but not limited to preparedness plans, preplanned dispatch plans, prescribed fire burn plans, and prevention plans. Fire Management Plans ensure that wildland fire management goals and components are coordinated.

Fire Management Unit: a land area definable by specified management objectives, constraints, topographic features, access, values to be protected, political boundaries, fuel types, major fire regime groups, and other defined elements that set it apart from an adjacent area. The primary purpose of developing Fire Management Units in fire management planning is to assist in organizing information in complex landscapes. A Fire Management Unit may have dominant management objectives and preselected strategies assigned to accomplish these objectives.

Fire prevention: activities such as public education, community outreach, law enforcement, engineering, and reduction of fuel hazards that are intended to reduce the incidence of unwanted human-caused wildfires and the risks they pose to life, property, or resources.

Fire regime: long-term pattern of fire behavior across a given landscape and vegetation community. Fire regimes are classified in terms of frequency (average number of years between fires) and severity (amount of replacement of the overstory vegetation).

Fire resources: all personnel and equipment available or potentially available for assignment to incidents.

Fire return interval: the number of years between two successive fires in a designated area.

Fire severity: a term related to the environmental impacts caused by a fire.

Fire suppression: all work and activities connected with control and fire-extinguishing operations, beginning with discovery and continuing until the fire is completely extinguished.

Flame length: the height of flames from a wildfire or prescribed fire, above the ground surface.

Forage: woody or non-woody vegetation such as grasses, forbs, and shrubs that are eaten by wildlife and/or livestock.

Forb: a plant with a soft rather than woody stem that is not a grass.

Forest health: the perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance. Note perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a point in time.

Free thinning: the removal of trees to control stand spacing and favor desired trees, using a combination of thinning criteria without regard to crown position.

Fuel: combustible living and dead material including vegetation such as trees, shrubs, grasses, snags, downed logs, tree needles, and other leaf litter that feeds a fire.

Fuelbreak: a natural or human-made change in fuel characteristics which affects fire behavior so that fires burning into them can be more readily controlled.

Fuel loading: the amount of fuel present expressed quantitatively in terms of weight of fuel per unit area. This may be available fuel (consumable fuel) or total fuel and is usually dry weight.

Fuel management: act or practice of controlling flammability and reducing resistance to control of wildland fuels through mechanical, chemical, biological, or manual means, or by fire, in support of land management objectives.

Fuel model: a description of fuels within an area that helps managers describe or simulate how a fire might behave, given other factors that can influence fire behavior (weather and topography).

Fuel treatment: manipulation or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control (e.g., lopping, chipping, crushing, piling and burning).

Gap: small opening created in a forest canopy, generally from windthrow. Gaps may result from loss of a single tree, or from a larger group of down trees. Gap formation is an important aspect of change and regeneration in many forests.

GIS (geographic information system): computer program(s) used to store, organize, and display geographic information spatially, such as roads, streams, soil types, or any other feature that can be mapped on the ground.

Ground cover: all herbaceous plants and low-growing shrubs in a forest or open area.

Group: a cluster of two or more trees with interlocking or nearly interlocking crown at maturity, surrounded by an opening. The size of tree groups is variable and depends on the forest community and sited conditions. Trees within groups are not uniformly spaced and trees may be tightly clumped.

Habitat: the environment in which a plant or animal lives.

Habitat diversity: the variety of wildlife habitat features and types in a specific area.

Habitat type: a system of site classification using the floristic composition of plant communities (understory species as well as trees) as an integrated indicator of those environmental factors that affect species reproduction, growth, competition and, therefore, community development.

Hand thinning: the use of hand tools such as chainsaws, brush cutters, loppers, and other methods that do not require the use of heavy machinery, vehicles, or similar equipment.

Harvest: cutting and gathering a tree crop for utilization. In a forest harvest, trees are felled and moved to a central location (landing) for final transport by trucks.

Hazard: any real or potential condition that can cause injury, illness, or death of personnel, or damage to or loss of equipment or property.

Heavy fuels: fuels of large diameter such as snags, logs, and large limb wood, which ignite and are consumed more slowly than flash fuels. Also called coarse fuels.

Herbaceous vegetation: non-woody plants, for example, grasses, forbs, wildflowers, and ferns.

Home range: the area an animal uses to satisfy its normal requirements for food, water, and cover.

Hydrologic unit code: a sequence of letters or numbers that identifies a hydrological feature such as a lake, river reach, or watershed. Hierarchical classification system that identifies a particular hydrologic drainage basin.

Hydrophobic: resistance to wetting exhibited by some soils, also called water repellency. The phenomenon may occur naturally or may be fire-induced. It may be determined by water drop penetration time, equilibrium liquid-contact angles, solid-air surface tension indices, or the characterization of dynamic wetting angles during infiltration.

Intermittent waterbody: a stream in which the flow of water on the surface is discontinuous, or that alternates between zones of surface and subsurface flow.

Interspaces: the open space between tree groups intended to be managed for grass-forb-shrub vegetation during the long term. Interspaces may include scattered single trees.

Invasive plants or noxious weeds: plants that possess one or more of the following attributes: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier of serious insect or disease, and may or may not have been part of a native plant community.

Jackpot burn: a modified form of broadcast burning where the target fuels are in concentrated pockets but not piled.

Jurisdiction: the range or sphere of authority. Public agencies have jurisdiction at an incident related to their legal responsibilities and authority for incident mitigation. Jurisdictional authority at an incident can be political/geographical (e.g., city, county, state or federal boundary lines), or functional (e.g., police department, health department, etc.).

Ladder fuels: vegetation fuels that provide vertical continuity, thereby allowing fire to carry from surface fuels into the crowns of trees with relative ease. They help initiate and assure crowning.

Landing: a central location where logs are gathered for transport to the mill.

Litter: the uppermost layer of organic debris on a forest floor, composed mainly of fresh or slightly decomposed leaves, bark, twigs, flowers, fruits, and other vegetable matter.

Log: section of the main stem of a harvested tree.

Mastication: reducing forest vegetation in the stand by grinding, shredding, or chopping woody material. Typically done with a masticator, shredder, or chipper machine.

Mature tree: a tree that has attained most of its potential height growth.

Mechanical treatment: cutting and removing trees using chainsaws, feller-bunchers, and skidders.

Mitigation measure: an activity or limitation placed upon a project activity to avoid or minimize adverse effects.

Model: a simplified or generalized representation of reality; a description, analogy, picture, or hypothesis to help visualize something that cannot be directly observed.

Monitoring: physical and biological evaluation of project activities to determine how well objectives are being met and if the effects of the activities are within those projected during the analysis.

Monoculture: the cultivation or growth of a single crop or organism, especially on agricultural or forest land.

Montane: referring to the climate, ecosystems, or species found in mountains.

Mosaic: the spatial arrangement of habitat where there is stand heterogeneity, measured at many spatial scales from the patch, the stand, and the vegetative community.

Nonnative invasive species: plant or animal species that are not native to a particular place and are causing disruption of the natural process of that place, displacing native plant and animal species, and degrading natural communities, among other disruptions.

Nutrient cycling: the circulation of chemicals necessary for life, from the environment (mostly from soil and water) through organisms and back to the environment.

Old growth: a late stage of forest succession beyond the age of biological maturity or stands that contain old-growth characteristics including numerous large trees, large snags, and logs on the ground.

Openings: spatial breaks between groups or patches of trees containing grass, forb, shrub, and/or tree seedlings, but that are largely devoid of big trees.

Organic matter: that fraction of the soil that includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population.

Overstocked: a condition in which trees are so closely spaced that they are competing for required resources, resulting in less than full growth potential for individual trees.

Overstory: the trees in a forest of more than one story that form the upper canopy layer.

Particulate matter: the microscopic particles that are part of smoke.

Perennial waterbody: a stream that flows throughout most (greater than 50%) of the year.

Pile burning: activity fuels, once piled by machine or by hand, are burned in place.

PM2.5: particulate matter of mass median aerodynamic diameter (MMAD) less than or equal to 2.5 micrometers.

PM10: particulate matter of MMAD less than or equal to 10 micrometers.

Pole: a tree of a size between a sapling and a mature tree.

Pre-commercial thinning: the removal of trees not for immediate financial return but to reduce stocking to concentrate growth on the more desirable trees.

Prescribed fire: a fire ignited by management actions under specified environmental conditions and following appropriate precautionary measures to achieve specific objectives. Prescribed fires are typically conducted in the spring or fall when temperatures are cool, humidity is high, and fire behavior is moderate. Prescribed fires are monitored by firefighters to ensure they remain within the area designated for burning.

Prescription: a schedule of activities for a stand or forest property which, when carried out, should produce the outcome desired by the landowner.

Protected activity center (PAC): an area that is a minimum of 600 acres surrounding known owl nest/roost sites. Protected activity centers are intended to sustain and enhance areas that are presently, recently, or historically occupied by breeding Mexican spotted owls.

Quadratic Mean Diameter: the measure of average tree diameter conventionally used in forestry, rather than the arithmetic mean diameter.

Rate of spread: the relative activity of a fire in extending its horizontal dimensions. It is expressed as rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually, it is expressed in chains or acres per hour for a specific period in the fire's history.

Recreation opportunity spectrum: a classification system that describes different outdoor recreation settings across the forests using seven standard classes that range from primitive, undeveloped settings to urban, highly developed settings. Attributes typically considered in describing the settings are size, scenic quality, type, and degree of access, remoteness, level of development, social encounters, and the amount of on-site management.

Regeneration: the replacement or renewal of a forest stand by natural or artificial means. Also, the term “regeneration” may refer to the young tree crop itself.

Residence time: the time, in seconds, required for the flaming front of a fire to pass a stationary point at the surface of the fuel. The total length of time that the flaming front of the fire occupies one point.

Residual stand: trees remaining uncut following any cutting operation.

Resiliency: the capacity of a (plant) community or ecosystem to maintain or regain normal function and development following a disturbance.

Restoration: the process of returning ecosystems or habitats to desired structure and species composition.

Riparian: the land and vegetation bordering flowing or standing water, identified by distinctive saturated soil characteristics and vegetation that require water (streams, lakes, ponds).

Risk: 1) the chance of fire starting as determined by the presence and activity of causative agents;

2) a chance of suffering harm or loss; 3) a causative agent; 4) in the National Fire Protection Association Standards, a number related to the potential of firebrands to which a given area will be exposed during the rating day.

Road decommissioning: activities that result in the stabilization and restoration of unneeded roads to a more natural state.

Sapling: a tree that is no longer a seedling but not yet a pole, usually at least 4.5 feet tall and 1.0 to 4.9 inches in diameter.

Sawtimber: trees, or logs cut from trees, with suitable diameter and stem quality for conversion to lumber.

Sedimentation: the filling-in of stream channels or waterbodies with soil particles, usually as a result of erosion on adjacent land.

Seedling: a young tree, usually less than 3 feet high and less than 1 inch in diameter.

Sensitive species: plant and animal species identified by a regional forester for which population viability is a concern as evidenced by significant current or predicted downward trends in population or habitat capability that would reduce a species' distribution.

Sensitive viewpoint: campground, picnic areas, trailheads, trails, or developed areas.

Seral: a temporal and intermediate stage in the process of succession. The different stages of succession are often referred to as seral stages or states. Developmental stages are as follows:

> **early seral:** Communities that occur early in the successional path and generally have less complex structural developmental than other successional communities. Seedling and sapling size classes are an example of early seral forests.
>
> **mid-seral:** Communities that occur in the middle of the successional path. For forests, this usually corresponds to the pole or medium sawtimber growth stages.
>
> **late seral:** Communities that occur in the later stage of the successional path with mature, generally larger individuals, such as mature forests.

Severity: the quality or state of distress inflicted by a force. The degree of environmental change caused by a disturbance (e.g., fire).

Shade-intolerant species: species that require sunlight to establish and grow.

Shade-tolerant species: species that grow well in shady conditions.

Silviculture: the art, science, and practice of establishing, tending, and reproducing forest stands.

Site: the combination of biotic, climatic, topographic, and soil conditions of an area.

Skidder: specialized logging equipment used to slide logs from stump to landing. Skidders are typically rubber tired or track mounted. Some are modified tractors equipped with either cable and winch, or a hydraulic grapple.

Skidding: moving trees from the felling site to a landing, using tractors or other logging equipment.

Skyline yarding: a thinning method that uses a system of cables to drag logs or whole trees from the cutting unit to a roadside landing.

Slash: branches, treetops, bark, and other woody material left on the ground as a byproduct of thinning (activity-produced slash).

Slope percent: the ratio between the amount of vertical rise of a slope and horizontal distance as expressed as a percent. For example, 100 feet of rise to 100 feet of horizontal distance equals 100 percent.

Snag: a standing dead or dying tree that has lost most of its branches.

Soil productivity: the capacity of a soil to produce a specific plant or sequence of plants under a specific system of management.

Soil stability: the potential of soil-covered slopes to withstand and undergo movement.

Stand: a group of trees sufficiently uniform in species composition, structure, and spatial arrangement to be distinguished from surrounding groups of trees.

Stand density: a quantitative measure of how completely a stand of trees occupies a site, usually expressed in terms of number of trees, or tree basal area per acre or per hectare.

Stand density index: a relative measure of competition in a forest stand based on number of trees per unit area and average tree size.

Stand structure: the presence, size, and physical arrangement of vegetation in a stand. Vertical structure refers to the variety of plant heights from the canopy to the forest floor. Horizontal structure refers to distribution of trees and other plants across the land surface.

State and transition model: nonequilibrium ecological model to describe vegetation dynamics of rangeland sites as adopted by the Natural Resources Conservation Service. Models recognize multiple steady states of vegetation and emphasize disturbance processes.

Structural stage: a stage of development of a vegetation community that is classified on the dominant processes of growth, development, competition, and mortality.

Succession: the ecological process of sequential replacement by plant communities on a given site as a result of reproduction and competition.

Suppressed trees: trees with crowns below the general level of the canopy and receiving no direct sunlight. Suppressed trees are characterized by low growth rate and low vigor due to competition with overtopping trees.

Suppression: a wildfire response strategy to “put the fire out” as efficiently and effectively as possible, while providing for firefighter and public safety. Also known as “perimeter containment” and “control.” The goal of this strategy is to minimize acres burned.

Surface fire: a fire that burns over the forest floor, consuming litter, killing aboveground parts of herbaceous plants and shrubs, and typically scorching the bases and crowns of trees.

Surface fuel: fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low-stature living plants.

Sustainability: for this environmental impact statement, the capacity of an ecosystem for long-term maintenance of ecological processes and functions, biological diversity, and productivity.

System road: roads under the jurisdiction of the U.S. Forest Service and necessary for protection, administration, and use of the National Forests.

Thin from below: a method of thinning that involves cutting the smallest trees in the stand up to a specified diameter limit. Also called "low thinning."

Thinning: removing some trees in a forest stand to provide growing space for other trees, and/or to remove dead or dying trees to reduce pest problems.

Threatened: a species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Torching: fires igniting and flaring up from the bottom to the top of a tree or group of trees.

Torching index: the open (6.1-m) windspeed at which crown fire activity can initiate for the specified fire environment**.**

Treatment: any silvicultural practice or procedure.

Uncharacteristic Fire: fires that burn large areas with excessive severity, such as the Los Conchas or Cerro Grande fires. 'High-severity wildlife' may be used interchangeably.

Understory: trees and other vegetation that grow beneath the overstory of a forest stand. Understory vegetation usually consists of grasses, forbs, and herbs; shrubs, bushes, and brush; and small immature trees (saplings).

Uneven-aged stand: a group of trees of a variety of ages and sizes and often of different species.

Upland: areas away from coastlines and the floodplains of streams, creeks, rivers, and other bodies of water.

Upland function: the ability of the uplands to allow for the retention of precipitation and maintain and improve soil condition.

Values at risk: property, structures, physical improvements, natural and cultural resources, community infrastructure, and economic, environmental, and social values.

Validation: assessing/confirming the current site conditions, selecting the appropriate management activities based on the analyzed criteria, and confirming the potential effects from those activities are accounted for in the environmental analysis decision.

Vegetation Structural Stages: a method for describing the growth stages of a stand of living trees. VSS are based on tree size (diameter) and total canopy cover. The system is used to group forest cover types into categories of similar growth conditions. There are six classes:

- VSS 1: grass/forb/shrub
- VSS 2: less than 5 inches diameter (seedling-sapling)
- VSS 3: 5 to 12 inches diameter (young forest)
- VSS 4: 12 to 18 inches diameter (mid-aged forest)
- VSS 5: 18 to 24 inches diameter (mature forest)

- VSS 6: greater than 24 inches diameter (old trees)

Wildland fire: a general term describing any non-structure fire that occurs in vegetation or natural fuels. Includes prescribed fire and wildfire.

Wildlife habitat: the arrangement of food, water, cover, and space required to meet the biological needs of an animal. Different wildlife species have different habitat requirements.

Water bar: a ditch or hump constructed diagonally across trails or roads to reduce soil erosion by diverting surface water runoff into adjacent ditches or vegetation.

Watershed: the total land area from which water drains into a particular stream or river.

Water yield: the amount of water "produced" by the watershed, i.e., the difference between precipitation and evapotranspiration.

Wildland-urban interface: the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetation fuels.

Woodland: a forest with low tree densities, often defined as less than 20% to 30% crown cover when trees are mature.

Woody debris: the dead and downed material on the forest floor consisting of fallen tree trunks and branches

Santa Fe Mountains Landscape Resiliency Project

Appendices

Appendix A. Mexican Spotted Owl Desired Conditions

The project area lies with the Southern Rocky Mountains ecological management unit (SRM EMU) for the Mexican spotted owl (MSO). Ecological management units are geographical subdivisions of the owl range established by the U.S. Fish and Wildlife Service to organize owl recovery efforts. At the time of publication of the MSO Recovery Plan, the SRM ERU contained approximately 5.6% of MSO sites known to occur in the United States and Mexico (U.S. Fish and Wildlife Service 2012). Recovery habitat is defined as MSO habitat outside of protected activity centers occurring in mixed conifer, ponderosa pine-oak, riparian forests, and/or rocky canyons (U.S. Fish and Wildlife Service 2012). Forested recovery habitat includes mixed conifer and pine-oak forests outside of protected activity centers. Mixed conifer forest is the primary habitat type used by the MSO in the project area for nesting, roosting, foraging, dispersal, and/or other life history needs. Ponderosa pine forest and other habitats, such as pinyon-juniper, are used for foraging, dispersal, and wintering. Mixed conifer is used by the MSO for all activities.

Recovery nest/roost habitat is defined as either currently is suitable or has the potential to develop into suitable nest/roost habitat. The MSO Recovery Plan guidance is for this habitat to be managed to maintain or to replace nest/roost habitat lost due to disturbance or senescence and to provide additional nest/roost habitat to facilitate recovery of the owl and greater dispersal of owl populations. Forested non-nest/roost recovery habitat that does not have potential to serve as nest/roost habitat should be managed for other life history needs (such as foraging, dispersing, or wintering) provided that key habitat elements are retained across the landscape.

MSO habitat in the project area is at risk of high-severity wildfires and density-related mortality. There is a need to improve habitat resiliency by reducing the potential for these disturbances in protected activity centers and recovery habitat. Development of future habitat in forest stands that are not currently suitable for nesting and roosting or provide only marginal habitat is also desirable.

Uneven-aged management strategies are needed to improve nesting and roosting habitat and reduce the potential loss of habitat. Existing, late-seral stands would be maintained or restored where necessary across the landscape. Management practices should favor uneven-aged management with an emphasis on retaining or promoting the development of large trees; retaining large hardwoods and large snags of all species; developing spatial heterogeneity; and managing for species diversity.

Desired Conditions and Management Guidance for Protected Activity Centers:

The following minimum parameters have been established within nest cores in established protected activity centers:

- Ensure stands have a minimum basal area of 120 square feet per acre and a minimum density of 15 trees per acre in the greater than 18-inch diameter at breast height (dbh) size class.
- Maintain a minimum of 60% canopy cover in mixed conifer vegetation.
- Ensure that trees in the 12- to 18-inch dbh size class comprise at least 30% of the stand basal area and that trees in the greater than 18-inch dbh size class comprise at least 30% of the stand basal area.
- Retain dead and down woody material and snags according to current MSO Recovery Plan guidelines.

The following minimum parameters have been established outside of nest cores in established protected activity centers:

- Strive for tree species diversity, especially with a mixture of hardwoods and shade-tolerant species, to be improved and maintained.

- Strive for diverse composition of vigorous native herbaceous and shrub species to be improved and maintained.
- Emphasize the retention of large hardwoods.
- Maintain a minimum of 60% canopy cover in mixed conifer forest. Pure ponderosa pine stands would be managed to appropriate canopy cover requirements. Canopy cover would be managed within stands.
- Trees greater than 16 inches dbh would contribute at least 50% of the stand basal area
- Opening sizes would vary between 0.1 and 2.5 acres. Openings within a forest are different than natural meadows. Small canopy gaps within forested patches provide for prey habitat diversity. Openings should be small in nest/roost core areas, may be larger in rest of protected activity center. Two to five tree clumps will be retained in openings. The shape of the openings should fall along natural features and look as natural as possible.
- Create a diversity of patch sizes with minimum patch size of 2.5 acres with larger patches near activity center; mix of sizes towards periphery. Forest type may dictate patch size (i.e., mixed conifer forests have larger and fewer patches than pine-oak forest). Strive for between-patch heterogeneity.
- Strive for horizontal and vertical habitat heterogeneity within patches, including tree species composition.
- Trees greater than 18 inches dbh should not be removed unless there are compelling safety reasons to do so or if it can be demonstrated that removal of these trees would benefit owl habitat. This should be done judiciously and only when truly necessary to meet specific resource objectives.
- Retain dead and downed woody material and snags according to current MSO Recovery Plan guidelines.

Desired Conditions for Recovery Nest/Roost Habitat:

The following minimum parameters have been established to promote the retention or development of suitable recovery nest/roost habitat (outside of established protected activity centers):

- Identify forested stands that currently meet or exceed owl nest/roost conditions or where such conditions can be reasonably obtained in time.
- Maintain stands set aside (25%, see nest/roost mapping) as recovery nest/roost habitat within the parameters of Table C3 of the 2012 MSO Recovery Plan.
- Strive for tree species diversity, especially with a mixture of hardwoods and shade-tolerant species, to be improved and maintained.
- Strive for diverse composition of vigorous native herbaceous and shrub species to be improved and maintained.
- Emphasize the retention of large hardwoods.
- Strive for a diversity of patch sizes with a minimum contiguous patch size of 1.0 to 2.5 acres. Forest type may dictate patch size (i.e., mixed conifer forests have larger and fewer patches than pine-oak forest). Strive for between-patch heterogeneity.
- Strive for horizontal and vertical habitat heterogeneity within patches, including tree species composition.

- Opening sizes would vary between 0.1 to 0.5 acres. Openings within a forest are different than natural meadows. Small canopy gaps within forested patches provide for prey habitat diversity. Openings should be small in nest/roost patches, may be larger in rest of protected activity center. A tree clump would be retained in larger openings. The shape of the openings should fall along natural features and look as natural as possible.
- Maintain a minimum of 60% canopy cover in mixed conifer forest.
- Maintain a minimum of 30% BA of trees 12 to 18 inches dbh
- Maintain a minimum of 30% BA of tress with >18 inches dbh
- Maintain a minimum of 27.5 BA m^2/hectare (ha) (120 square feet/acre)
- Maintain a minimum of tree density of 30 large trees (>12 inches dbh) per hectare.
- Trees greater than 18 inches dbh should not be removed unless there are compelling safety reasons to do so or if it can be demonstrated that removal of those areas would enhance owl habitat. This should be done judiciously and only when truly necessary to meet specific resource objectives.
- Retain 10 to 15 tons per acre of downed logs at 12 inches midpoint at least 8 feet long unless this conflicts with forest restoration and/or owl habitat.
- Retain dead and down woody material and snags according to current MSO Recovery Plan guidelines.

Desired Conditions for Forested Recovery Habitat (Non-Nest/Roost):

The following minimum parameters have been established in this unit to promote the retention or development of forested recovery habitat that is suitable for foraging, dispersal, and wintering (outside of established protected activity centers):

- Strive for spatial heterogeneity by incorporating natural variation, such as irregular tree spacing and various stand/patch/group/clump sizes.
- Emphasize the retention of large hardwoods.
- Retain most trees greater than 18 inches dbh when possible and strive to retain (do not cut) all trees greater than 24 inches dbh, unless overriding management situations require their removal to protect human safety and/or property (e.g., the removal of hazard trees along roads, in campgrounds, and along power lines).
- Retain the five largest snags per acre with an emphasis of greater than 18 inches dbh unless overriding management situations require their removal to protect human safety and/or property (e.g., the removal of hazard trees along roads, in campgrounds, and along power lines).
- Retain 10 to 15 tons per acre of downed logs at 12 inches midpoint at least 8 feet long unless this conflicts with forest restoration and/or owl habitat.
- Retain dead and down woody material and snags according to current MSO Recovery Plan guidelines.

Mexican Spotted Owl Critical Habitat:

The U.S. Fish and Wildlife Service (2005) identified primary constituent elements in the August 2004 designation of MSO critical habitat. Primary constituent elements are those physical and biological features necessary to ensure conservation of the species. Critical habitat includes only protected and restricted habitats as defined in the original recovery plan (U.S. Fish and Wildlife Service 1995).

The primary constituent elements of critical habitat include habitat features recognized as being associated with MSO occupancy. The following parameters, designed to promote an uneven-aged forest structure and provide for adequate prey species, would also be followed within designated critical habitat (U.S. Fish and Wildlife Service 2012):

- Maintain a range of tree species, including mixed conifer, pine-oak, and riparian forest types, composed of different tree sizes reflecting different ages of trees. Trees greater than 12 inches dbh would comprise 30% to 45% of a stand.
- Maintain a “shaded canopy” with a minimum of minimum of 40% canopy cover.
- Maintain snags greater than 12 inches dbh;
- maintain high volumes of fallen trees and other woody debris.
- Maintain a wide range of tree and plant species, including hardwoods.
- Maintain adequate levels of residual plant cover to maintain fruits and seeds and allow plant regeneration.

Appendix B. Species of Conservation Concern Report

Species of Conservation Concern (SCC) Forest Plan Consistency for Santa Fe Mountains Resiliency Project

November 18, 2022

At-risk species identified for the Santa Fe Forest Plan revision include federally classified endangered, threatened, proposed, and candidate species, as described under the ESA (1973), and species of conservation concern (SCC) (USDA FS Santa Fe NF 2022). SCC are species, other than federally recognized species, that are known or expected to occur on the Santa Fe NF and for which the Regional Forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long term. For SCC, habitat management and compatible multiple uses will be accomplished in a way that ensures species' persistence on the Santa Fe NF, in accordance with the 2012 Planning Rule (36 CFR § 219.9(b)).

Analysis of biological resource data, including habitat assessment and field reconnaissance, determined that the following twelve SCC species may occur or have suitable habitat within the project area; Pacific marten, Gunnison's mariposa lily, Lewis's woodpecker, wood lily, Pinyon jay, American peregrine falcon (foraging habitat), Greene's milkweed, large yellow lady's slipper, masked shrew, northern goshawk, northern leopard frog and water shrew. These species were evaluated for forest plan compliance, specifically for Standards (S), Guidelines (G) and Desired Condition (DC). Twenty-one SCC species, including one Federal Candidate species (Rio Grande cutthroat trout), were not considered for further analysis based on lack of suitable habitat or occurrence (USDA Santa Fe NF 2022).

See Appendix C of the Final Environmental Assessment for the project to see the Design Features, Best Management Practices (BMPs) and Mitigation Measures. These Design Features, BMPs and mitigation measures were developed in an interdisciplinary setting in order for the project to attain project consistency with the 2022 Forest Plan.

Plan Code	Plan Component	SCCs	Project Consistency
FW-VEG-DC-1	Ecosystems maintain all of their essential components (e.g., plant density, species composition, structure, coarse woody debris, and snags), processes (e.g., disturbance and regeneration), and functions (e.g., nutrient cycling, water infiltration, and carbon sequestration); a) Ecosystems contain a mosaic of diverse native plants (e.g., composition and genetic diversity) with vegetative structural diversity that encourages vigor, connectivity and persistence at a variety of scales across the landscape, reflecting their natural disturbance regimes, b) Native plant communities dominate the landscape, while invasive species are nonexistent or low in abundance and do not disrupt ecological functioning, c) Natural ecological cycles (e.g., hydrologic, energy, and nutrient) facilitate the shifting of plant communities, structure, and ages over time due	Pacific marten Gunnison's mariposa lily Lewis's woodpecker Wood lily Pinyon jay American peregrine falcon Greene's milkweed Large yellow lady's slipper Masked shrew Northern goshawk	The Project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks (a, b, c, d, f). For example, management actions include riparian restoration, with non-native plant removal and plantings of native species. and 1.5 miles of road closure (a, b, e). The Purpose and Need are consistent with SCC population viability goals for the species that may occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022).

Plan Code	Plan Component	SCCs	Project Consistency
	to natural ecological processes affecting site conditions (e.g., fire and climate fluctuations), d) Vegetation structural diversity and forest floor fuel loadings support native insect and disease populations within their range of natural variability, e) Vegetative cover and litter are distributed across the soil surface in adequate amounts to limit erosion and contribute to soil deposition and development. Soil cover and herbaceous vegetation protect soil, facilitate moisture infiltration, and contribute to plant and animal diversity and ecosystem function, f) Seral state proportions (per the 'Seral State Proportions for the Southwestern Region' supplement) are applied at the landscape scale, where contributions from all seral stages and low overall departure from reference proportions are positive indicators of ecosystem condition, g) At the scale of the plan unit, overall plant composition similarity to site potential (FSH 2090.11) averages greater than 66 percent, but can vary considerably at the mid- and fine- scales owing to a diversity of seral conditions.	Northern leopard frog Water shrew	
FW-VEG-DC-2	Ecosystems are resilient or adaptive to the frequency, extent, and severity of disturbances, such as fire in fire-adapted systems, flooding in riparian systems, insects, pathogens, and climate variability; a)The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances, and to climate variability, b) Vegetative communities reflect their natural physical, chemical, and biophysical processes with carefully managed human influence, c) Non-climate ecosystem stressors (e.g., high road densities, water depletions, and air and water pollution) do not significantly impact the resilience and resistance of an ecosystem's ability to adapt to a changing climate, d) Natural disturbance regimes, including fire, are allowed to function in their natural ecological role. Uncharacteristic fire (frequency and severity outside historical range for associated vegetation type) is minimal or absent on the landscape, e) Landscape vegetation structure and patterns create a mosaic that disrupts large continuous areas of uncharacteristic high-severity fire effects, f) Landscape vegetation structure and patterns create a mosaic that disrupts large continuous areas of uncharacteristic high-severity fire effects.	Pacific marten Gunnison's mariposa lily Lewis's woodpecker Wood lily Pinyon jay American peregrine falcon Greene's milkweed Large yellow lady's slipper Masked shrew Northern goshawk	The Project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks (a, c, d). Management actions include riparian restoration in Arroyo Hondo (approx. 370 acres) and Tesuque Creek (approx. 310 acres), including non-native plant removal and plantings of native species. and 1.5 miles of road closure (FR 79W). The Purpose and Need are consistent with SCC population viability goals for the species that may occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMPs and Mitigation Measures.

Plan Code	Plan Component	SCCs	Project Consistency
FW-VEG-DC-3	The ecological attributes and processes that provide habitat for native biota and/or historic and cultural values are maintained or restored; a) diversity of vegetation exists with a mosaic of cover types and stand structures forming a healthy, resilient landscape that provides for genetic exchange, habitat connectivity for daily and seasonal movements of animals, including inter-specific interaction at all trophic levels, (e.g., producer-consumer and predator-prey interactions) across multiple spatial scales, consistent with existing landforms and topography, b) Vegetation provides a sustainable supply of timber and other forest products, such as firewood, piñon nuts, vigas and latillas, herbs, and forage, consistent with desired conditions for other resources, c) Habitats and refugia for rare, endemic, and culturally important species, are resilient to stressors and support species' persistence and recovery.	Pacific marten Gunnison's mariposa lily Lewis's woodpecker Wood lily Pinyon jay American peregrine falcon Greene's milkweed Large yellow lady's slipper Masked shrew Northern goshawk	The Project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks (a, c). The Purpose and Need are consistent with SCC population viability goals for the species that may occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures.
FW-VEG-G-1	Management activities should favor the retention of species that naturally occurred in those ecosystems. Native species should be present in the relative proportions characteristic of those ecosystems.	Pacific marten Gunnison's mariposa lily Lewis's woodpecker Wood lily Pinyon jay American peregrine falcon Greene's milkweed Large yellow lady's slipper Masked shrew Northern goshawk	The Project's Purpose and Need is consistent with the revised Forest Plan and includes direction to increase the resilience of forests and watersheds in the project area by moving frequent-fire forests toward their characteristic species composition (retention of native species), structure, and spatial patterns in order to improve ecological function. See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measure such as Plant -2 through Plant 8, Water – 6, Thin – 2 among others.
FW-VEG-G-2	Heavy equipment and log decks should not be staged in ecologically sensitive areas (e.g., riparian corridors, montane meadows, and highly erosive soils).	Pacific marten Lewis's woodpecker Large yellow lady slipper Masked shrew Northern leopard frog Water shrew	The Project includes design features and mitigations designed to be consistent with FW-VEG-G-2. No activities are proposed in montane meadows. See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Thin -1, Soil -1 through Soil -8, Water 4 and 8 among others.
FW-VEG-G-4	Vegetation treatments should be designed such that structural stages and age classes that are under-represented in desired conditions become proportionally represented, and to assure continuous recruitment of old growth	Pacific marten Lewis's woodpecker Northern goshawk	The project's Purpose and Need is consistent with Desired Conditions described in the Santa Fe National Forest Land Management Plan (2022), which stress the importance of retaining old growth and managing vegetation

Plan Code	Plan Component	SCCs	Project Consistency
	characteristics across the landscape over time.		in ways that support old growth development over time, and in turn support old growth-related SCC viability. No removal of trees over 16 inches in diameter (dbh) is proposed and the implementation of this project will move vegetation conditions toward late seral stages and ultimately toward desired condition.
FW-MCW-DC-1 *(Mixed conifer with aspen)*	The MCW vegetation community is composed of multiple species of varying ages in a mosaic of seral stages and structures. Its arrangement on the landscape is similar to historic patterns with groups and patches of variably sized and aged trees and other vegetation associations. Tree canopies are generally more closed than in dry mixed conifer. Seral state proportions are applied at the landscape scale, where contributions from all seral stages and low overall departure from reference proportions are positive indicators of ecosystem condition; a) Seral state proportions for MCW are: (See LMP p. 37), b) Patches are composed of variable species based on seral stages. Patch sizes vary, but are frequently hundreds of acres, with rare patches that are thousands of acres, as a result of infrequent disturbances, c) Old growth generally occurs over large areas as stands or forests where the location shifts on the landscape over time as a result of succession and disturbance. Old-growth components include old trees, dead trees (snags), downed wood (coarse woody debris), and structural diversity, d) MCW communities are predominately vigorous trees, but older declining, top-killed, lightning- and fire-scarred trees are a component that provide snags and coarse woody debris, all well-distributed throughout the landscape. Number of snags and downed logs (larger than 12-inch diameter at mid-point, over 8 feet long) and coarse woody debris (more than 3-inch diameter) vary by seral stage, e) Snags 18 inches or larger at DBH range from 1 to 5 snags per acre, where the lower range of snags of this size is associated with early seral stages and upper range is associated with late seral stages. Snag density in general (larger than 8 inches at dbh) averages 20 per acre. Coarse woody debris including downed logs, varies by seral stage, with averages ranging from 5 to 20 tons per acre for early-seral stages; 20 to 40 tons per acre for mid-seral stages; and 35 tons per acre or greater for late-seral stages, f) The understory consists of native grass, forbs, and shrubs. Shrub cover depends on the TEUI unit. At the plan unit scale, overall plant composition similarity to site potential (e.g., FSH 2090.11) averages more than	Gunnison's mariposa lily American peregrine falcon Large yellow lady's slipper Northern goshawk	Existing condition for MCW is at moderate departure from reference condition in the project area. Desired conditions described in the Santa Fe National Forest Land Management Plan (2022) stress the importance of retaining old growth and for managing vegetation in ways that support old growth development over time. This project is consistent with this direction (FW-MCW-DC-1) and no removal of trees over 16 inches in diameter is proposed and the implementation of this project will move vegetation conditions toward late seral stages and ultimately toward the desired condition.

Plan Code	Plan Component	SCCs	Project Consistency
	66 percent, but can vary considerably at finer scales due to a diversity of seral conditions.		
FW-MCW-DC-2	Vegetative conditions (composition, structure, and function) are broadly resilient to disturbances of varying frequency, extent, and severity. The forest landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g., insects, diseases, fire, and wind), including old trees, downed logs, and snags. Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and ecosystem function. Natural and human-caused disturbances maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling, a) Mixed and high-severity fires occur in MCW, with a fire return interval of 35 to 200 years or more (Fire Regimes III, IV, and V). Mixed-severity fire (Fire Regime III) is characteristic at lower elevations of this type. High-severity fires (Fire Regimes IV and V) are typically at higher elevations of this type, but rarely occur, b) Isolated instances of insect and disease infestations (e.g., spruce budworm, Douglas-fir tussock moth, dwarf mistletoe, or tent caterpillar) occur at endemic levels (within the natural range of variability, typically frequent small-scale) that do not affect the ecological function or sustainability of MCW.	Gunnison's mariposa lily American peregrine falcon Large yellow lady's slipper Northern goshawk	The project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks (a,b,c). The Purpose and Need are consistent with SCC population viability goals for species that may utilize riparian areas that occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022).
FW-MCW-DC-3	At the mid-scale, the size and number of tree groups and patches vary depending on disturbance, elevation, soil type, aspect, and site productivity (e.g., reference conditions indicate patches of 100 to 400 acres). Groups and patches of trees tens of acres or less are common and are primarily even aged, a) mosaic of groups and patches vary in species composition, age, and size. Openness and prevalence of some species (e.g., aspen) is dependent on seral stages. Aspen is occasionally present in large patches. Grass-forb-shrub openings created by disturbance may comprise 10 to 100 percent of the mid-scale area, depending on the type of and time since disturbance.	American peregrine falcon Large yellow lady's slipper Northern goshawk	The project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks (a,b,c). The Purpose and Need are consistent with SCC population viability goals and DC for species that may utilize MCW in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Wild -8, 10, 11, 12 among others.
FW-MCW-DC-6	Ground cover consists of shrubs, perennial grasses, and forbs with basal vegetation cover values ranging between 5 and 20 percent depending on site potential and TEUI unit.	American peregrine falcon Large yellow lady's slipper Northern goshawk	DCs and the Purpose and Need of the project are consistent with SCC population viability goals for species that may utilize ground cover in MCW habitat, including for foraging, within the project area.

Plan Code	Plan Component	SCCs	Project Consistency
FW-MCW-DC-7	Forest conditions in goshawk post-fledging family areas are similar to general forest conditions, except they typically contain 10 percent or higher tree density (basal area) relative to post-fledging family areas than goshawk foraging areas and the general forest. Nest areas have multi-aged forest conditions, with dominant large trees and relatively denser canopies than other areas in the MCW type.	Northern goshawk	DCs and the Purpose and Need of the project are consistent with FW-MCW-DC-7 and SCC population viability goals for northern goshawk, such as reducing risk of high intensity wildfire to maintain habitat in the long-term, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as NOGO – 3, 5, 6, 10, 11 among others.
FW-MCW-DC-10	Organic ground cover and herbaceous vegetation provide protection for soil and moisture infiltration and contribute to plant diversity and ecosystem function.	American peregrine falcon Large yellow lady's slipper Northern goshawk	DCs and the Purpose and Need of the project are consistent with FW-MCW-DC-10 and SCC population viability goals for species that may utilize MCW habitat, including for foraging, within the project area.
FW-MCD-DC-1 *(Mixed conifer-frequent fire)*	The MCD vegetation community is composed of multiple species of varying ages in a mosaic of seral stages and structures. The forest arrangement on the landscape is similar to historic patterns, with groups and patches generally of variably sized and aged trees (uneven-aged) and occasional patches of even-aged structure interspersed within variably sized openings of grass-forb-shrub vegetation. Denser tree conditions exist in some locations such as north-facing slopes and canyon bottoms. Canopies are generally more open than in mixed conifer with aspen stands. Seral state proportions are applied at the landscape scale, where contributions from all seral stages and low overall departure from reference proportions are positive indicators of ecosystem condition, a) Seral state proportions for MCD are: (See LMP p. 41), b) Groups of MCD vary in size (although typically small groups), shape, number of trees per group, and number of groups per area across the landscape, creating a mosaic of patchiness. Where they naturally occur, groups of aspen and all structural stages of oak (e.g., Gambel's oak) are present, c) MCD communities are composed predominantly of vigorous trees, but older declining, top-killed, lightning- and fire-scarred trees are a component that provide snags and coarse woody debris (more than 3-inch diameter), all well-distributed throughout the landscape. The understory consists of native grass, forbs, and shrubs, d) Old growth occurs throughout the landscape, generally in small areas as individual old-growth components or as clumps of old growth. Old-growth components include old trees, dead trees (snags), downed	Lewis's woodpecker Northern goshawk American peregrine falcon	In mixed conifer-frequent fire forest types (MCD) in the project area, meeting the DC for restoration would also achieve DC for wildfire risk reduction by reducing fuels and breaking fuel continuity in frequent-fire forest types and supporting seral state proportions. Desired conditions described in the Santa Fe National Forest Land Management Plan (2022) stress the importance of retaining old growth and for managing vegetation in ways that support old growth development over time. This project is consistent with this direction and consistent with SCC population viability goals for species that utilize old growth habitat. No removal of trees over 16 inches in diameter is proposed. The implementation of this project will move vegetation conditions toward late seral stages and ultimately toward the desired condition.

Plan Code	Plan Component	SCCs	Project Consistency
	wood (coarse woody debris), and structural diversity. The location of old growth shifts across the landscape over time as a result of succession and disturbance.		
FW-MCD-DC-2	Vegetative conditions (composition, structure, and function) are broadly resilient to disturbances of varying frequency, extent, and severity, and to climate variability. The forest landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g., insects, diseases, fire, and wind), including old trees, downed logs, and snags. Fire and other disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling, a) Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and ecosystem function. Shrub cover depends on the TEUI unit and disturbance, b) At the plan unit scale, overall plant composition similarity to site potential (e.g., FSH 2090.11) averages more than 66 percent, but can vary considerably at fine- and mid-scales due to a diversity of seral state conditions, c) Dwarf mistletoe occurs in less than 15 percent of host trees in uneven-aged forest structures and less than 25 percent in even-aged forest structures., d) Isolated instances of insect and disease infestations (e.g., spruce budworm, Douglas-fir tussock moth) occur at endemic levels (within the natural range of variability, typically frequent small-scale) that do not affect the ecological function or sustainability of MCD.	Lewis's woodpecker Northern goshawk American peregrine falcon	The project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks (a,b,d). In mixed conifer-frequent fire forest types (MCD) in the project area, meeting the DC for restoration would also achieve DC for wildfire risk reduction by reducing fuels and breaking fuel continuity in frequent-fire forest types. Additionally, prescribed fire has been documented to reduce dwarf mistletoe (c) within treated stands, which should increase vigor of MCD ERU over time. This is consistent with SCC population viability goals for species that utilize MCD.
FW-MCD-DC-3	Frequent, low-severity fires (Regime I) are characteristic in this type, including throughout goshawk home ranges. Fire return interval is 5 to 21 years. Grasses, forbs, shrubs, needle cast (fine fuels), and small trees maintain the natural fire regime, a) Natural and human-caused disturbances are sufficient to maintain desired overall tree density, structure, species compositions, coarse woody debris, and nutrient cycling.	Northern goshawk	The project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks. In mixed conifer-frequent fire forest types (MCD) in the project area, meeting the DC for restoration would also be consistent with FW-MCD-DC-3 for wildfire risk reduction by reducing fuels and breaking fuel continuity in frequent-fire forest types where northern goshawk may occur. See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as NOGO – 1, 4, 7, 8, 12, among others.
FW-MCD-DC-4	At the mid-scale, the size and number of tree groups and patches vary depending on disturbance, elevation, soil type, aspect, and site productivity. The more biologically productive	Lewis's woodpecker Northern	The project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change,

Plan Code	Plan Component	SCCs	Project Consistency
	sites contain more trees per group and more groups per area. Groups and patches of trees are primarily uneven aged with all age classes and structures present. Disturbances sustain the overall variation in age and structural distribution. Occasionally small patches (generally less than 60 acres) of even-aged forest structure are present, based on disturbance events and regeneration establishment, a) A small percentage of the landscape may be predisposed to larger even-aged patches, based on physical site conditions that favor mixed-severity and stand-replacement fire, and other disturbances.	goshawk American peregrine falcon	and insect outbreaks. In mixed conifer-frequent fire forest types (MCD) in the project area, meeting the DC for restoration would also be consistent with FW-MCD-DC-4 for wildfire risk reduction by reducing fuels and breaking fuel continuity in frequent-fire forest types. This is also consistent with SCC population viability goals for species that utilize MCD (i.e., nesting and foraging for Lewis's woodpecker, foraging for northern goshawk and peregrine falcon).
FW-MCD-DC-6	Snags are typically 18 inches or larger dbh and average 3 per acre. Smaller snags, 8 inches and larger dbh, average 8 snags per acre.	Lewis's woodpecker Northern goshawk American peregrine falcon	Desired Conditions for snags at the mid-scale in the project area are consistent with FW-MCD-DC-6 (i.e., snags would typically be 18 inches or larger at the diameter at breast height (dbh) and average 3 per acre). This is also consistent with SCC population viability goals for species that utilize MCD (i.e., nesting and foraging for Lewis's woodpecker, foraging for northern goshawk and peregrine falcon). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as NOGO – 1, 10, 16-22, MSO 11 among others.
FW-MCD-DC-8	Ground cover consists primarily of perennial grasses and forbs capable of carrying surface fire, with basal vegetation values ranging between about 5 and 20 percent, depending on site potential and TEUI unit. Fires burn primarily on the forest floor and do not spread between tree groups as crown fire.	Lewis's woodpecker Northern goshawk American peregrine falcon	Desired Conditions for ground cover at the mid-scale for the project are consistent with FW-MCD-DC-8. This is also consistent with SCC population viability goals for species that utilize MCD (i.e., nesting and foraging for Lewis's woodpecker, foraging for northern goshawk and peregrine falcon). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as NOGO – 1 among others.
FW-MCD-DC-9	Forest conditions in goshawk post-fledging family areas are similar to general forest conditions, except they typically contain 10 to 20 percent higher basal area in mid-old age tree groups than goshawk foraging areas and the general forest. Nest areas have multi-aged forest conditions, with dominant large trees and relatively denser canopies than are common in the rest of the mixed conifer-frequent fire type.	Northern goshawk	Desired Conditions and the Purpose and Need of the project are consistent with FW-MCD-DC-9 and SCC population viability goals for northern goshawk, such as reducing risk of high intensity wildfire to maintain habitat in the long-term, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as NOGO – 1 among others.

Plan Code	Plan Component	SCCs	Project Consistency
FW-MCD-DC-12	Interspaces surrounding groups are variably shaped, are composed of a native grass-forb-shrub mix and may contain individual trees or snags.	Lewis's woodpecker Northern goshawk American peregrine falcon	In mixed conifer-frequent fire forest types (MCD) in the project area, meeting the DC for restoration would also be consistent with FW-MCD-DC-12 and is also consistent with SCC population viability goals for species that utilize MCD.
FW-PPF-DC-1 *(Ponderosa pine)*	The PPF vegetation community is composed of trees of varying ages in a mosaic of seral stages and structures. The forest arrangement on the landscape is similar to historic patterns, with groups and patches generally of variably sized and aged trees (uneven-aged) and occasional patches of even-aged structure, interspersed within variably sized openings of grass-forb-shrub vegetation associations. Denser stand conditions exist in some locations, such as north-facing slopes and canyon bottoms. Seral state proportions are applied at the landscape scale, where contributions from all seral stages and low overall departure from reference proportions are positive indicators of ecosystem condition, a) Seral state proportions for PPF are: (See LMP p. 44), b) Groups of PPF vary in size (although typically small (a few trees to 1+ acre) shape, number of trees per group, and number of groups per area across the landscape, creating a mosaic of patchiness. Where they naturally occur, in the Gambel's oak sub-type, all structural stages of oak trees are present, c) The PPF vegetation community is predominantly composed of vigorous trees, but older declining, top-killed, lightning- and fire-scarred trees are a component that provides for snags and coarse woody debris (over 3-inch diameter), all well-distributed throughout the landscape, d) Old growth occurs throughout the landscape, generally in small areas (e.g., less than 1 acre) as individual old-growth components or as clumps of old growth. Old-growth components include old trees, dead trees (snags), downed wood (coarse woody debris), and structural diversity. The location of old growth shifts across the landscape over time as a result of succession and disturbance, e) Dwarf-mistletoe occurs in less than 15 percent of host trees in uneven-aged forest structures and less than 25 percent in even-aged forest structures. f Frequent, low-severity fires (Fire Regime I) are characteristic in this type, including throughout goshawk home ranges, with fire return intervals of 4 to 30 years. Fires burn primarily on the forest floor and do not spread between tree groups as crown fire. Grasses, forbs, shrubs, litter (e.g., cones, needles,	Lewis's woodpecker Wood lily American peregrine falcon Northern goshawk	PPF is in high departure (seral state departure) from reference condition on the SFNF and the existing condition for all dominant forest types in the project area is deficient of late seral/large tree stages. In PPF types in the project area, meeting the DC for restoration would also achieve DC for wildfire risk reduction by reducing fuels and breaking fuel continuity and also support old growth development. Desired conditions described in the Santa Fe National Forest Land Management Plan (2022) stress the importance of retaining old growth and for managing vegetation in ways that support old growth development over time. This project is consistent with this direction and consistent with SCC population viability goals for species that utilize PPF old growth habitat. No removal of trees over 16 inches in diameter is proposed. The implementation of this project will move vegetation conditions toward late seral stages and ultimately toward the desired condition.

Plan Code	Plan Component	SCCs	Project Consistency
	fine woody fuels, 10-hour-fuels, and previous years' debris from grasses, forbs, and shrubs), and small trees maintain the natural fire regime.		
FW-PPF-DC-2	Vegetative conditions (composition, structure, and function) are broadly resilient to disturbances of varying frequency, extent, severity, and to climate variability. The forest landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g., insects, diseases, fire, and wind), including old trees, downed logs, and snags. Natural and human-caused disturbances are sufficient to maintain desired overall tree density, structure, species compositions, coarse woody debris, and nutrient cycling, a) Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and ecosystem function. The understory consists of native grass, forbs, and shrubs. The amount of shrub cover depends on TEUI unit and disturbance. At the plan unit scale, overall plant composition similarity to site potential (e.g., FSH 2090.11) averages more than 66 percent, but can vary considerably at finer scales due to a diversity of seral conditions, b) Isolated instances of insect and disease infestations (e.g., bark beetle and dwarf mistletoe) occur at endemic levels (within the natural range of variability, typically frequent small-scale) that do not affect the ecological function or sustainability of PPF.	Lewis's woodpecker Wood lily American peregrine falcon Northern goshawk	The project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks (a,b). The Purpose and Need and project analysis within the EA are consistent with SCC population viability goals for species that utilize PPF habitat that occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022).
FW-PPF-DC-3	At the mid-scale, the size and number of tree groups and patches vary depending on disturbance, elevation, soil type, aspect, and site productivity. The more biologically productive sites contain more trees per group and more groups per area, resulting in less space between groups. Mosaics of tree groups and patches of trees make up an uneven-aged forest with all age classes present. Disturbances sustain the overall variation in age and structural distribution, a) Occasionally small patches (generally less than 50 acres) of even-aged forest structure are present, based upon disturbance events and regeneration establishment, b) A small percentage of the landscape may be predisposed to larger even-aged patches, based on physical site conditions that favor mixed-severity and stand-replacement fire, and other disturbances.	Lewis's woodpecker Wood lily American peregrine falcon Northern goshawk	The project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks. In PPF habitat within the project area, meeting the DC for restoration would also be consistent with FW-PPF-DC-3 for wildfire risk reduction by reducing fuels and breaking fuel continuity in PPF types.
FW-PPF-DC-5	Openness typically ranges from 52 percent in more productive sites to 90 percent in less productive sites. In areas with high fine-scale aggregation of trees into groups, mid-scale openness ranges between 78 to 90 percent.	Wood lily	In PPF habitat within the project area, meeting the DC for restoration would be consistent with FW-PPF-DC-5 and consistent with SCC population viability goals for species that utilize open areas within PPF habitat. See

Plan Code	Plan Component	SCCs	Project Consistency
			Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Wild 8, 10, 11 among others.
FW-PPF-DC-6	Ponderosa pine snags are typically 18 inches or larger at dbh and average 1 to 2 per acre. In the Gambel oak subtype, large oak snags (larger than 10 inches) are a well-distributed component.	Lewis's woodpecker American peregrine falcon Northern goshawk	Desired Conditions for snags at the mid-scale for the project are consistent with FW-PPF-DC-6 (i.e., snags would typically be 18 inches or larger at the diameter at breast height (dbh) and average 3 per acre). See section 1.4 of the Final EA for existing and desired conditions. This is also consistent with SCC population viability goals for species that utilize PPF snags (i.e., nesting and foraging for Lewis's woodpecker, foraging for northern goshawk and peregrine falcon). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Wild -15, NOGO – 1, 10, 16-22 among others.
FW-PPF-DC-7	Coarse woody debris, including downed logs, vary by seral stage but typically range from 3 to 10 tons per acre. Downed logs (larger than 12-inch diameter at mid-point, over 8 feet long) average 3 logs per acre within the forested area (not interspaces) of the landscape.	Lewis's woodpecker American peregrine falcon Northern goshawk	Desired Conditions for coarse woody debris at the mid-scale for the project are consistent with FW-PPF-DC-7 (i.e., coarse woody debris, including downed logs, typically range from 5 to 15 tons per acre). This is also consistent with SCC population viability goals for species that utilize coarse woody debris in PPF (i.e., nesting and foraging for Lewis's woodpecker, foraging for northern goshawk and peregrine falcon). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Wild- 4, 15, 19, 20 Thin – 3, NOGO – 1, 10, 16-22 among others.
FW-PPF-DC-8	Ground cover consists primarily of perennial grasses and forbs capable of carrying surface fire, with basal vegetation values ranging between about 5 and 20 percent depending on site potential and the TEUI unit.	Lewis's woodpecker American peregrine falcon Northern goshawk	Desired Conditions for ground cover at the mid-scale for the project area are consistent with FW-PPF-DC-8. This is also consistent with SCC population viability goals for species that utilize PPF (i.e., nesting and foraging for Lewis's woodpecker, foraging for northern goshawk and peregrine falcon).
FW-PPF-DC-11	Tree groups are typically less than 1 acre in size, but average 0.5 acre and are sometimes larger on north-facing slopes. In mid-aged and older forests, groups consist of approximately 2 to 40 trees.	Lewis's woodpecker American peregrine falcon Northern goshawk	Desired Conditions for PPF at the mid-scale for the project are consistent with FW-PPF-DC-11. This is also consistent with SCC population viability goals for species that utilize PPF habitat and require larger DBH trees (i.e., nesting and foraging for Lewis's woodpecker, foraging for northern goshawk and peregrine falcon). See Appendix C of the Final Environmental Assessment for the project to

Plan Code	Plan Component	SCCs	Project Consistency
			see the Design Features, BMP and Mitigation Measures such as Wild -8 among others.
FW-PPF-DC-13	Interspaces surrounding groups are variably shaped, are a native grass-forb-shrub mix, and may contain individual trees or snags.	Lewis's woodpecker American peregrine falcon Northern goshawk	Desired Conditions for PFF at the mid-scale for the project are consistent with FW-PPF-DC-13 and are consistent with SCC population viability goals for species that utilize PFF, such as Lewis's woodpecker. See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Wild -8, 10 and 11 among others.
FW-JUG-DC-1 *(Pinyon juniper grassland and juniper grassland)*	The PJG and JUG vegetation communities are composed of trees of varying ages in a mosaic of seral stages and structures. The forest arrangement on the landscape is similar to historic patterns, with groups and patches generally of variably sized and aged trees (uneven-aged) and occasional patches of even-aged structure, interspersed within variably sized openings of grass/forb/shrub vegetation associations. Denser stand conditions exist in some locations, such as north-facing slopes and canyon bottoms. Canopies are more open than in piñon-juniper woodland stands. Seral state proportions are applied at the landscape scale, where contributions from all seral stages and low overall departure from reference proportions are positive indicators of ecosystem condition, a) Seral state proportions for PJG and JUG are: (See LMP, p. 49), b) PJG and JUG are generally uneven-aged and open in appearance. Trees occur as individuals, but occasionally in smaller groups, and range from young to old, c) Old growth occurs throughout the landscape, generally in small areas as individual old-growth components, or as clumps of old growth. Old-growth components include old trees, dead trees (snags), downed wood (coarse woody debris), and structural diversity. The location of old growth shifts across the landscape over time as a result of succession and disturbance, d) Frequent, low-severity fires (Fire Regime I) are characteristic in this type, with fire return intervals of 8 to 36 years e) Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and ecosystem function. The understory consists of native grass, forbs, and shrubs; the amount of cover depends on site potential and disturbance.	Lewis's woodpecker Pinyon jay	The project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks. Treatments proposed for the project which aid in restoring and protecting PJG and JUG habitats from high intensity fire events are consistent with FW-JUG-DC-1. The Purpose and Need are consistent with SCC population viability goals for species that utilize JUG habitat, such as pinyon jay, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022).

Plan Code	Plan Component	SCCs	Project Consistency
FW-JUG-DC-2	Vegetative conditions (composition, structure, and function) are broadly resilient to disturbances of varying frequency, extent, and severity, and to climate variability. The landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g., insects, diseases, fire, and wind), including old trees, downed logs, and snags. Natural and human-caused disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling. a) At the plan unit scale, overall plant composition similarity to site potential (e.g., FSH 2090.11) averages more than 66 percent, but can vary considerably at finer scales due to a diversity of seral conditions, b) Isolated insect and disease infestations (e.g., Ips beetle) occur at endemic levels (within the natural range of variability, typically frequent small-scale) that do not affect the ecological function or sustainability of PJG or JUG.	Lewis's woodpecker Pinyon jay	The project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks. Desired Conditions for this ERU group within the project area, consisting of pinyon-juniper woodlands, pinyon-juniper grasslands, and juniper grasslands, are focused on mitigation of future fire behavior from potential crown fire to surface fire, with lower flame lengths and rates of spread. Proposed treatments which aid in restoring and protecting PJG and JUG habitats from high intensity fire events are consistent with FW-JUG-DC-2.
FW-JUG-DC-3	Snags are scattered across the landscape, averaging 5 snags per acre for snags 8 inches diameter and larger, while snags 18 inches and larger average 1 snag per acre. Coarse woody debris increases in later successional stages and averages 1 to 3 tons per acre.	Lewis's woodpecker Pinyon jay	Desired Conditions for snags and course woody debris at the mid-scale for the project are consistent with FW-JUG-DC-3 (i.e., coarse woody debris increases in later successional stages and averages 1 to 3 tons per acre). This is also consistent with SCC population viability goals for species that utilize snags in JUG habitat (Lewis's woodpecker). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Wild -16, 17, 18, 19 among others.
FW-JUG-DC-5	Ground cover consists primarily of perennial grasses and forbs capable of carrying frequent surface fire, with basal vegetation values averaging between 10 and 30 percent, depending on site potential and the TEUI unit. Shrubs average less than 30 percent canopy cover.	Lewis's woodpecker Pinyon jay	Desired conditions for ground cover in the project area are consistent with FW-JUG-DC-5. The Purpose and Need of the project are consistent with SCC population viability goals for species that may utilize ground cover in MCW habitat, including for foraging, within the project area.
FW-JUG-DC-6	PJG and JUG are generally uneven-aged and open in appearance. Trees occur as individuals, but occasionally in smaller groups, and range from young to old.	Lewis's woodpecker Pinyon jay	Although predicted to remain in low departure from reference conditions, piñon-juniper habitats may have the greatest variation on the SFNF, with regard to climate change vulnerability (USDA FS Santa Fe NF 2022). Desired conditions for PJG and JUG habitats for SCC in the project area are consistent with FW-JUG-DC-6.
FW-PJO-DC-2 (*Pinyon juniper woodland*)	Old growth includes old trees, dead trees (snags), downed wood (coarse woody debris) and structural diversity and is often concentrated in mid- and fine-scale units as patches of old growth. The location of old growth shifts on the	Pinyon jay	The project's Desired Conditions and Purpose and Need are consistent with FW-PJO-DC-2, as described in the Santa Fe National Forest Land Management Plan (2022), which stress the importance of retaining old growth

Plan Code	Plan Component	SCCs	Project Consistency
	landscape over time as a result of succession and disturbance. Very old trees (over 300 years old) are present, while snags and older trees with dead limbs and/or tops are scattered across the landscape, a) Snags 8 inches DRC or larger, average 5 snags per acre, while snags 18 inches DRC or larger average 1 snag per acre, b) Coarse woody debris increases in later successional stages and averages 2 to 5 tons per acre.		and managing vegetation in ways that support old growth development over time. No removal of trees over 16 inches in diameter (dbh) and 12 inches DRC is proposed for PJO. See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Wild -13, 16, 17, 18, 19 among others.
FW-PJO-DC-3	At the plan unit scale, overall plant composition similarity to site potential (e.g., FSH 2090.11) averages more than 66 percent, but can vary considerably at fine- and mid- scales owing to a diversity of seral conditions.	Pinyon jay	The project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks. Desired conditions for PJG habitat for SCC in the project area are consistent with FW-PJO-DC-3 and the implementation of this project will move toward desired conditions.
FW-PJO-DC-4	The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances (e.g., insects, diseases, and fire), as well as climate variability. a Fire as a disturbance is less frequent and variable due to differences in ground cover. The fires that do occur are mixed to high severity (Fire Regime III, IV, and V) and generally fine scale. b Isolated insect and disease infestations (e.g., Ips beetle) occur at endemic levels (within the natural range of variability, typically frequent small-scale) that do not affect the ecological function or sustainability of piñon-juniper.	Pinyon jay	Although predicted to remain in low departure from reference conditions, piñon-juniper habitats may have the greatest variation on the SFNF, with regard to climate change vulnerability. Desired Conditions for this ERU group within the project area are focused on mitigation of future fire behavior from potential crown fire to surface fire, with lower flame lengths and rates of spread. Proposed treatments which aid in restoring and protecting PJO from high intensity fire events are consistent with FW-PJO-DC-4. See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Ips 3, 4, 5 among others.
FW-PJO-DC-6	Ground cover consists of shrubs, perennial grasses, and forbs, and ranges between 5 and 15 percent, depending on site potential and the TEUI unit.	Pinyon jay	Desired conditions for ground cover in the project area are consistent with FW-PJO-DC-6. The Purpose and Need of the project are consistent with SCC population viability goals for species that utilize ground cover in PJO habitat, such as Pinyon jay, within the project area.
FW-RWE-DC-1	Riparian ecosystems have a diverse composition of desirable native plants that contain a mosaic of communities, creating a structurally robust vegetative network that protects the soils from unnatural erosion. Departure from site potential is low (less than 33 percent) (Wahlberg et al. 2013), a) Woody vegetation within forested and shrubland riparian areas and wetland ecosystems display a variety of size classes; they provide terrestrial and aquatic habitats, stream shading (temperature regulation), woody channel debris, aesthetic values, and other ecosystem functions, b) Invasive plant species are absent (per Desired Condition 1 in Wildlife: Nonnative and Invasive	Pacific marten Lewis's woodpecker Large yellow lady's slipper Masked shrew Northern leopard frog Water shrew	The project is designed to improve ecosystem resilience for a priority landscape to future disturbances such as wildfire, climate change, and insect outbreaks (a, b, c, d). Desired Conditions and the Purpose and Need are consistent with SCC population viability goals for the species that may occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). Management actions include riparian restoration in Arroyo Hondo (approx. 370 acres) and Tesuque Creek (approx. 310 acres), including non-native plant removal and

Plan Code	Plan Component	SCCs	Project Consistency
	Species), c) Riparian communities are free from encroachment by upland species and the extent of riparian communities is expanding or has achieved potential extent, d) The composition, structure, and function of biotic and abiotic components of the HERB riparian vegetation community are within the natural range of variability. i. Seral state proportions for HERB riparian are: (See LMP, p. 76), e) The composition, structure, and function of biotic and abiotic components of the FSR vegetation communities are within the natural range of variability. i. Desired seral stage proportions for FSR-CWG at landscape scale: (See LMP, p. 76). ii. Desired seral stage proportions for FSR- MCWG at landscape scale: (See LMP, p. 77). iii. Woody riparian species are reproducing and are structurally diverse with all age classes present. Diverse vegetation structure, including mature trees, snags, logs, and coarse woody debris, is present to provide habitat for riparian-dependent species. iv. Dense willow conditions (70 percent cover or greater) are retained as high value wildlife habitat. v. Upland, dry-site vegetation is not encroaching, and the extent of riparian communities is widening or has achieved its potential and is within the natural range of variability.		plantings of native species. and 1.5 miles of road closure (FR 79W). Old-growth components would include old trees, dead trees (snags), downed wood (coarse woody debris), and structural diversity needed to support habitat needs and population viability for SCC (i.e., Pacific marten). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Water- 1 through Water - 11, Rx – 5 through Rx -10, Thin -2 through Thin - 6, NOGO - 9 among others.
FW-RWE-DC-2	Riparian and wetland ecosystems have highly productive soils that maintain vegetative cover sufficient to catch sediment, dissipate energy, prevent erosion, stabilize stream banks and shorelines, provide aquatic and terrestrial wildlife habitat, and promote floodplain development. Low departure (0 to 33 percent similarity, LANDFIRE departure formula) from site potential expressed for basal vegetation or bare ground for given TEUI units (Miller et al. 1993), area-weighted for all TEUI units within an analysis area, a) Long-term impacts to soils (e.g., soil erosion, soil compaction, soil displacement, puddling, and severely burned soils) are rare or non-existent on all riparian area and wetland ecosystems, b) Moist soil conditions (e.g., thick litter layers, wet areas, coarse woody debris, and decaying debris) are maintained and well-distributed, within the capacity of the vegetation community for at-risk species, c) Riparian areas should retain a value of more than 30 pieces coarse woody debris per mile (more than 18 per kilometer), diameter larger than 12 inches (larger than 30 centimeters), length over 35 feet (over 10 meters) based on what is considered proper functioning condition, d) Coarse woody debris provides habitat and is being adequately	Pacific marten Large yellow lady's slipper Masked shrew Northern leopard frog Water shrew	The project is designed to improve ecosystem resilience for a priority landscape to future disturbances such as wildfire and climate change. Desired Conditions and the Purpose and Need are consistent with SCC population viability goals for the species that may occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). Management actions include riparian restoration in Arroyo Hondo (approx. 370 acres) and Tesuque Creek (approx. 310 acres), including non-native plant removal and plantings of native species. and 1.5 miles of road closure (FR 79W). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Water- 1 through Water - 11, Rx – 5 through Rx -10, Thin -2 through Thin - 6, NOGO - 9 among others.

Plan Code	Plan Component	SCCs	Project Consistency
	recruited, to provide a reliable source of replacement, e) Riparian forest vegetation provides basic life-cycle needs (e.g., nesting, foraging) for riparian-dependent wildlife species (e.g., Neotropical migrant birds, at-risk species), f) Nectar sources (e.g., buttercup, monkey flower, mountain bluebell, and field mint) are available for at-risk species.		
FW-RWE-DC-3	Riparian areas have a low departure from historic fire regime (0 to 33 percent similarity, LANDFIRE departure formula), a) Compared to surrounding uplands, perennial riparian corridors have characteristics (e.g., surface water and saturated soils) that reduce the frequency and severity of fire. Fire is limited or absent and mixed- to high-severity fire occurs very infrequently.	Pacific marten Large yellow lady's slipper Masked shrew Northern leopard frog Water shrew	The project is designed to improve ecosystem resilience for a priority landscape to future disturbances such as wildfire and climate change. The Purpose and Need are consistent with SCC population viability goals for the species that may occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). Desired Conditions for this ERU within the project area are focused on mitigation of future fire behavior from potential crown fire to surface fire, with lower flame lengths and rates of spread. Proposed treatments which aid in restoring and protecting PJO from high intensity fire events are consistent with FW-RWE-DC-3. Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as, Rx – 5, 6, and 7 among others.
FW-RWE-DC-4	Riparian areas and wetland ecosystems meet the standards defined by proper functioning condition metrics (e.g., USDI 2015 and USDI 2020). RE and WE are supported by surface and subsurface flow regimes that contribute to stream-channel and floodplain development, maintenance, and function, which maintain soil moisture necessary for riparian connectivity and for the regeneration of native plants that depend on flooding or high water tables; a) Stream channels, riparian areas, and wetland ecosystems are resilient to ecological disturbances (e.g., floods, fire, drought, and changes in climate) and human activities (e.g., roads, livestock, and recreation), b) RE and WE are widening or have achieved potential extent and are within their natural range of variability, c) Overall wetland condition score of 'A' or 'B' or equivalent rating for proper functioning condition (USDI 2015 and USDI 2020).	Pacific marten Large yellow lady's slipper Masked shrew Northern leopard frog Water shrew	The project is designed to improve ecosystem resilience for a priority landscape to future disturbances such as wildfire and climate change. The Purpose and Need are consistent with SCC population viability goals for species that may utilize riparian areas that occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). Management actions include riparian restoration in Arroyo Hondo (approx. 370 acres) and Tesuque Creek (approx. 310 acres), including non-native plant removal and plantings of native species. and 1.5 miles of road closure (FR 79W). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Water- 1 through Water - 11, Rx – 5 through Rx -10, Thin -2 through Thin - 6
FW-ATRISK-DC-2	Intact, functioning, and sufficient habitat for terrestrial and aquatic at-risk species (defined by Desired Conditions for each Vegetation ERU) provide for opportunity for breeding, feeding, nesting, and other critical life history needs of	Pacific marten Gunnison's mariposa lily Lewis's	The Desired Conditions and Purpose and Need of the project are consistent with SCC population viability goals for species that may utilize riparian areas in the project area, as described in the revised Forest Plan (USDA FS

Plan Code	Plan Component	SCCs	Project Consistency
	wildlife, so the species remains viable and persistent on the landscape.	woodpecker Wood lily Pinyon jay American peregrine falcon Greene's milkweed Large yellow lady's slipper Masked shrew Northern goshawk Northern leopard frog Water shrew	Santa Fe NF 2022). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures many of which pertain to SCC and At-Risk Species.
FW-ATRISK-G-1	All authorized activities should be designed and implemented to address threats to at-risk species and their habitats, including, but not limited to: a) Timing restrictions to encourage reproductive success,; b) Prevention of introduction of non-game invasive, competing, or predatory species (these are species directly and negatively impacting at-risk species populations), and prevention of introduction of nonnative game species to novel locations, c) Prevention or introduction of pathogens leading to population impacts, d) Creation or removal of obstructions that may alter natural migration or directly cause mortality to wildlife; and e) Avoiding or protecting small or isolated populations.	Pacific marten Gunnison's mariposa lily Lewis's woodpecker Wood lily Pinyon jay American peregrine falcon Greene's milkweed Large yellow lady's slipper Masked shrew Northern goshawk Northern leopard frog Water shrew	The project is designed to improve ecosystem resilience of a priority landscape to future disturbances such as wildfire and climate change. The Desired Conditions and Purpose and Need are consistent with SCC population viability goals for the species that may occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Wild -1 through Wild - 26, MSO - 4, 8, 9, 13 among others.
FW-ATRISK-G-5	The forest should use the most current ecological guidelines to improve nesting conditions for goshawk (*Accipiter gentilis*): a) A minimum of three goshawk nest areas and three replacement nest areas should be located per goshawk territory. Goshawk nest and replacement nest areas should generally be located in drainages, at the base of slopes, and on northerly (northwest to northeast) aspects. Nest areas should generally be 25 to 30 acres in size. b Goshawk post-fledging areas of approximately 420 acres should be designated surrounding nest sites. c In goshawk foraging areas and post-fledging family areas, groups of three to five reserve trees should be retained within management-created	Northern goshawk	Desired Conditions for forest conditions in northern goshawk post-fledging areas at the mid-scale in the project area are consistent with FW-ATRISK-G-5. Wildlife design features would limit disturbance during project implementation and minimize risks to reproduction and nesting habitat. These limitations support SCC population viability goals for the species that may occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation

Plan Code	Plan Component	SCCs	Project Consistency
	openings greater than 1 acre in ponderosa pine communities, and six reserve trees (VSS class 5 or 6) should be retained within management-created openings greater than 0.5 acre in spruce-fir communities. d In occupied goshawk nest areas, human presence should be minimized between March 1 and September 30 (per Guideline 1a in this section).		Measures such as NOGO -1 through NOGO – 13 among others.
FW-ATRISK-G-11	Even-aged management treatments in piñon-juniper habitat should avoid creating a sharp, well-defined edge between dense woodlands and recovered shrublands for foraging habitat of at-risk species.	Pinyon jay	Desired conditions for PJG and JUG habitats to support SCC population viability in the project area are consistent with FW-PJO-DC-2 and FW-ATRISK-G-11. See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Wild – 13 among others.
FW-TERRASH-DC-1	Terrestrial ecosystems are composed of appropriate (native) assemblages of sustainable populations of plant and animal species that are supported by healthy ecosystems, a) A diversity of habitat components, including biotic and abiotic features, are available at the appropriate spatial, temporal, compositional, and structural levels (as defined by Desired Conditions for each Vegetation ERU) to provide adequate opportunity for breeding, feeding, nesting, and other critical life history needs of wildlife, so that forest species remain viable and persistent on the landscape, b) Undesired nonnative and invasive terrestrial species, as well as introduced pathogens, are rare or absent (per Desired Condition 1 in Wildlife: Nonnative and Invasive Species), c) Terrestrial habitats allow for the maintenance and promotion of interspecific relationships at all trophic levels (e.g., producer-consumer and predator-prey relationships) across multiple scales, consistent with existing landforms and topography.	Pacific marten Gunnison's mariposa lily Lewis's woodpecker Wood lily Pinyon jay American peregrine falcon Greene's milkweed Large yellow lady's slipper Masked shrew Northern goshawk Northern leopard frog Water shrew	The project is designed to improve ecosystem resilience for a priority landscape to future disturbances such as wildfire, climate change, and insect outbreak (a,b). Proposed actions include non-native plant removal and plantings of native species in riparian areas. The Desired Conditions and Purpose and Need are consistent with overall SCC population viability goals for the species that may occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures.
FW-TERRASH-DC-2	Habitat configuration, connectivity, and availability allow wildlife populations to adjust their movements in response to major disturbances (e.g., climate change or uncharacteristic fire) and promote genetic flow between wildlife populations.	Pacific marten Lewis's woodpecker Pinyon jay Masked shrew Northern goshawk Northern leopard frog Water shrew	The Purpose and Need of the project is consistent with SCC population viability goals for species that may utilize riparian areas that occur in the project area, as described in the revised Forest Plan (USDA FS Santa Fe NF 2022). Management actions that would support habitat connectivity include riparian restoration in Arroyo Hondo (approx. 370 acres) and Tesuque Creek (approx. 310 acres), including non-native plant removal and

Plan Code	Plan Component	SCCs	Project Consistency
			plantings of native species, and 1.5 miles of road closure (FR 79W). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Wild - 12 among others.
FW-SOIL-G-2	During forest management activities such as thinning and prescribed fire, large woody material should be retained to meet desired conditions relevant to the ERU to support nutrient cycling.	Pacific marten Wood Lily	The project's Purpose and Need is consistent with Desired Conditions described in the Santa Fe National Forest Land Management Plan (2022). See Appendix C of the Final Environmental Assessment for the project to see the Design Features, BMP and Mitigation Measures such as Wild – 15 through Wild 21, Soil – 5, 6 and 8 among others.

Appendix C. Design Features, Best Management Practices, and Mitigation Measures

Design Features, Best Management Practices, and Mitigation Measures

This section contains additional information regarding how project activities under the proposed action alternative would be implemented. It includes a list of design features, best management practices (BMPs), and mitigation measures, as defined below:

- BMPs: guidelines or minimum standards for the proper application of management activities and operations.
- Design Features: a list of management actions that are designed to guide implementation of on-the-ground activities to achieve desired conditions while minimizing adverse effects. Design features are integral to and considered part of the Proposed Action.
- Mitigation Measure: an activity or limitation that is implemented in conjunction with a project activity in order to avoid, minimize, or eliminate adverse impacts that could result from implementation of the Proposed Action (40 CFR 1508.20).

The analysis of effects presented in Chapter 3 assumes the implementation of relevant design features, BMPs, and mitigation measures as they apply to the proposed conditions-based management actions. Monitoring measures are included in a separate monitoring plan, see Appendix D. The measures listed below are based on Forest Plan direction and policy, best available science, site-specific evaluations and other relevant policies, guidelines, standards.

All Activities

Best Management Practices

10. Purpose: Communicate project and policy requirements to all parties involved in implementing management activities

11. General-1 Implementation, layout and prep personnel, including the U.S. Forest Service, partners, contractors and others, would be briefed on all applicable design features, resource protection measures, BMPs, and standards and guidelines from the Forest Plan, etc. prior to implementation, between phases and as needed, such as, as personnel changes.

12. Purpose: Minimize litter, waste, and other human-caused disturbances during project implementation.

13. General-2 Santa Fe NF employees and contractors would follow Leave No Trace practices, including packing out all trash, burying human waste properly, and respecting wildlife that may be encountered.

14. Purpose: Public safety and coordination.

15. General-3 Recreation sites, roads, trails, or other areas scheduled for treatment may be temporarily closed during treatment activities to ensure public safety. Project activities would be coordinated with potentially affected adjacent landowners, range allotment permittees, special use permittees, and any other permit holders as needed to minimize access impacts.

Botany and Invasive Species/Weeds

16. Best Management Practices

17. Purpose: Prevent the spread and establishment of noxious and invasive weeds.

18. Plant-1 Weed prevention educational materials would be provided to fuelwood cutters and gatherers as part of the permitting process.

19. Mitigation Measures

20. Purpose: Prevent the spread and establishment of noxious and invasive weeds. Manage sensitive plant habitat.

21. Plant-2 All off-road equipment (e.g., masticators, OHVs) would be weed-free prior to entering the project area. Staging of equipment would be done in weed free areas. Equipment would be pressure-washed, inspected and weed-free (includes free of soil, seeds vegetative matter and other debris) before entering the project area and before moving between treatment areas.

22. Plant-3 Areas of noxious and invasive weeds would be avoided except for treatments that may be designed to reduce weed populations.

23. Plant-4 Disturbance areas such as staging areas and parking areas would be located outside of known weed areas by at least 300 feet. GIS mapping layers. Forest/District Weed specialist and a U.S. Forest Service Biologist would be consulted prior to treatments.

24. Plant-5 Fire lines would not be constructed through or within 150 feet of invasive weed sites.

25. Plant-6 If project implementation calls for seed mixes, mulches or fill, they would be State-certified as weed-free. Seed mixes used for re-vegetation of disturbed sites would consist of locally adapted native plants to the extent practicable.

26. Plant-7 If deemed necessary for successful riparian restoration, herbicides would be applied to non-native species within riparian areas in a manner that is consistent with the SFNF Invasive Plant Control Project ROD (U.S. Forest Service 2018).

27. Plant-8 Coordination with resources specialists and applicable partnering agencies would occur to determine appropriate mitigation measures necessary to protect HGI during implementation of proposed treatments. Example mitigation could include flagging and avoiding the area.

Ips Beetle

28. Design Features

29. Purpose: Prevent the establishment and spread of Ips beetle infestations.

30. Ips-1 Slash would be treated promptly through lop/scatter, chipping, mastication, hand pile burning, or prescribed burning. Concentrations of chipped/masticated material would not be allowed to accumulate over 4 inches in depth on more that 20% of treatment unit. Chipped/masticated materials would be distributed on slopes where they would dry quickly.

31. Ips-2 Activity fuels would be disposed of as soon as possible and typically would not remain for more than two years depending on burn windows.

32.

33.

34. Mitigation Measures

35. Purpose: Prevent the establishment and spread of Ips beetle infestations.

36. Ips-3 When practical, activity slash would be created only between July through December unless the potential for Ips infestation is determined to be low.

37. Ips-4 Creating activity slash in adjacent treatment areas would be avoided for multiple years if risk of beetle infestation is determined to be high by the Silviculturist.

38. Ips-5 Mechanical damage would be avoided to residual trees and their root systems to reduce risk of attracting bark beetles.

Hydrology and Riparian Resources

39. Best Management Practices

40. Purpose: Communicate project and policy requirements to all parties involved in implementing management activities.

Water-1. Activities in drainage bottoms (i.e., near stream channels and within swales) would be coordinated with wildlife, fisheries, and watershed personnel.

41. Purpose: To maintain water quality

Water-2. To prevent introducing chemical pollutants to waterbodies and soils, all equipment would be washed, clean and free of leaks prior to entering the project area. Regularly inspect equipment for leaks during use.

Water-3. Spill containment materials (e.g., impermeable containment berms, absorbent pads, etc.) would be required on site to ensure that spilled fuel would not leave the staging and fueling areas.

Water-4. Fueling and equipment staging/maintenance areas would be located outside of Riparian Management Zones (RMZ[4]) and would only be the minimum size needed for their function. Existing landings and non-system routes within RMZs may be used (given aquatic, biologic, or watershed specialist coordination) if water quality concerns can be abated through prevention measures.

Design Features

42. Purpose: To minimize noxious weed spread and re-establish native vegetation.

Water-5. Where livestock have access to seeps and springs, trees would be felled directionally around the RMZ of these features to protect them from livestock access.

Water-6. For riparian planting activities:

---

[4] **Riparian Management Zones (RMZ)** *are defined by either a site-appropriate delineation of the riparian area (including one site potential tree height) or a buffer of 100 feet from the edges (e.g., each bank) of all perennial and intermittent streams, lakes, seeps, springs, and other wetlands or 15 feet from the edges of the ephemeral channels. The exact width of RMZs may vary based on ecological or geomorphic factors or by waterbody type but includes those areas that provide riparian and aquatic ecosystem functions and connectivity. The waterbody itself is considered part of the RMZ.*

- Where possible, source plants from local, native stock.
- Plant appropriate riparian species for the ERU.
- Monitor plantings shortly after implementation; where necessary, fence plantings from herbivory (especially within active range allotments).
- Do not plant in periods of drought, during or prior to dry seasons.

Mitigation Measures

43. Purpose: To minimize erosion, promote soil productivity, and to maintain water quality.

Water-7. The RMZ is largely an equipment exclusion area. Vehicles, including heavy equipment (such as dozers, masticators), plows and ATV/UTVs, would be only minimally operated within RMZs when absolutely necessary. If vehicles must enter the RMZ, they would not be driven within a stream channel but would stick to designated routes and crossings as described in Water-6. Operation plans would be coordinated with watershed personnel.

Water-8. Motor vehicles (including ATV/UTVs and heavy equipment) would only cross stream channels at designated crossing areas; perennial stream crossings would be designated in consultation with a watershed or aquatic habitat specialist. Where routes cross ephemeral or intermittent channels, crossing would be done when channels are dry. Stream channels would not be crossed where equipment would cause bank breakdown. Woody debris or rock may be placed into crossings to reduce soil disturbance and compaction. Upon completion of use, the crossing would be rehabilitated to maintain a stable channel.

Water-9. New and existing landings, campsites, helipads, and drop points, would be located outside of RMZs and would only be the minimum size needed for their function.

Water-10. New and existing landings, campsites, helipads, drop points, fueling and equipment staging/maintenance areas would be evaluated post-treatment (and decommissioned when no longer needed) to facilitate soil recovery and prevent erosion.

Water-11. Prior to periods of wet weather, and immediately after an area has been treated, erosion control measures (e.g., waterbars, rolling dips) would be installed on all fireline, access routes, and staging areas. Waterbars would be installed with the maximum spacing dependent on slope gradient (Table C.1), have an open outlet, constructed lead-off, berm tied into the cut-bank, a 2% to 4% outslope, and a skew of 30 to 45 degrees (from perpendicular to the travel route), with a height (crown to trough) of 12 to 18 inches.

Table C.1. Waterbar Construction Guidelines

Gradient (%)	Spacing (feet)
<5	200
5–10	150
10–20	100
21–40	50
>40	25

Best Management Practices

44. Purpose: To minimize soil erosion, maintain soil productivity and maintain water quality.

Rx-1. If water drafting sites are needed for the project, they would meet BMPs[5] prior to use, during use and after final use for this project's completion.

Rx-2. Water drafting sites would only be used after coordination with a U.S. Forest Service Biologist. Drafting sites would not be used where they contain whirling disease or Chytrid fungus. To avoid the inadvertent spread of these organisms, water drafting equipment would be decontaminated before use in the project area, between different water sources, and after implementation is complete. Refer to guidance found in Preventing Spread of Aquatic Invasive Organisms Common to the Southwest Region Technical Guidelines for Fire Operations, Interagency Guidance Rev. August 2009 or more recent, and the Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations (https://www.nwcg.gov/publications/444).

Rx-3. Screens would be used to prevent organism entrapment during water drafting.

Rx-4. Drafting would not completely dewater any water feature; enough water would remain for aquatic and wildlife species.

Design Features

45. Purpose: To minimize soil erosion, maintain soil productivity and maintain water quality.

Rx-5. To reduce fuel loads around stream channels and water bodies but maintain vegetation and duff, low-intensity prescribed fire may occur within the RMZ. Fire ignition however would not take place within the RMZ. Fire would be allowed to back down in the RMZ.

Rx-6. Pre-treat (hand thin vegetation) within the RMZ as needed to avoid moderate and high intensity fire within the RMZ.

Rx-7. Wherever possible, slash piles would be built outside of the RMZ, drainage bottoms, and swales (valley bottoms). If slash piles mush be constructed in these areas, consult a watershed specialist for best placement. If slash must remain in these areas, scattering slash is preferred to piling. If piling must occur within these areas, the following would apply:

a) Piles would be stacked as far from the channel and riparian vegetation as possible; where no riparian vegetation exists, piles would be stacked as far away from the channel as possible (at least 25 feet from the channel and outside the high-water zone).
b) Piles would be built small (<100 square feet each) in order to minimize fire residence time and subsequent soil impacts.
c) Not all piles would be burned; maintain some unburned piles.
d) Piles would be burned when soil moistures are high, or when snow is on the ground.
e) If slash must be piled in windrows, rows would be along the contour and would not be in drainage bottoms.

[5] U.S. Forest Service: FS-990a. National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1. April 2012. https://www.fs.fed.us/naturalresources/watershed/pubs/FS_National_Core_BMPs_April2012.pdf

f) Burn pile composition should contain a mixture of fuel sizes. Large woody fuels, over 8.9 inches in diameter, should be limited to less than 40% of the composition of the pile to prevent adverse impacts to the soil.

Mitigation Measures

46. Purpose: To minimize soil erosion, maintain soil productivity and maintain water quality.

Rx-8. Follow the implementation strategy for avoiding adverse cumulative watershed effects (CWEs) by the proposed action, as described in Appendix F.

Rx-9. Water sources would not be contaminated with foaming agents.

Rx-10. Fireline would not be installed parallel to stream channels and would intersect stream channels as perpendicular as possible; fireline width would be minimal, only as large as needed.

Riparian Thinning Activities

Best Management Practices

47. Purpose: To maintain water quality and minimize soil erosion.

48. Thin-1 Operators of masticators and other heavy equipment should strive to disturb the soil as little as possible; wherever possible, machines should not execute abrupt pivot turns, but instead make as broad of an arc as the terrain will allow. Machines should not cause ruts more than 4” deep. Masticators would use low psi tracks/tires.

Design Features

49. Purpose: To maintain and re-establish native vegetation.

50. Thin-2 Other riparian species (willows, cottonwood, aspen, etc.) would not be cut or removed unless for transplanting, with the exception of some, but not all, aspen could be cut to promote regeneration in areas where health and vigor are insufficient.

51. Purpose: To maintain streambank stability and water quality

52. Thin-3 To maintain natural bank protection and shade, large, downed wood in stream channels would remain in place and bank stability trees (large trees >12 inches dbh with roots in the bank and/or branches directly over the bank) would be left.

53. Thin-4 Maintain stream shade within the RMZ; consult a watershed specialist if thinning activities may substantially reduce stream shade. Where necessary or desired, plant site appropriate riparian species.

54. Thin-5 Galisteo Creek is not meeting state water quality standards for temperature and has an associated total maximum daily load (TMDL), which recommends increasing the percentage total shade from 8 to 81. Consult a watershed specialist when developing thinning prescriptions which may affect shade over this stream. Promote stream shade.

Mitigation Measures

55. Purpose: To maintain water quality and minimize soil erosion.

56. Thin-6 So as to prevent disturbance by motor vehicles, do not promote fuelwood gathering by the public within the RMZ.

57. Thin-7 Machine piling of activity-generated slash would be conducted in a manner that minimizes the amount of soil displaced into burn piles. Duff and litter layers would be left as intact as possible.

58. Thin-8 Where it would not cause fuel loading or Ips beetle concerns, use slash to help infiltrate runoff, prevent erosion, and treat eroded areas.

59. Thin-9 Wherever possible, fell hillslope trees on contour; leave large sections of the boles
(1000-hour fuels) in contact with the soil for the purpose of slowing overland flow as well as catching eroded soil, seeds, and nutrients. These logs should serve to quickly re-generate vegetation and filter water. This is especially important on south and west facing slopes.

Thin-10 Depth of masticated materials should not exceed an average of 4 inches and materials should be discontinuous at the quarter-acre scale to protect the soil and allow for natural revegetation.

Soils

Best Management Practices

60. Purpose: To minimize soil erosion and maintain soil productivity.

Soil-1. UTVs and ATVs may be used for transportation around the project area during implementation. To the extent possible, travel on existing routes and trails; if off-route travel must occur, avoid travelling across side-slopes; attempt to travel on ridges.

Soil-2. To protect road infrastructure from rutting, travel to and from the project area on Forest roads and trails would be limited during periods when resource damage could occur.

Soil-3. To the extent possible, existing disturbance areas (e.g., user created routes, staging areas, access trails) would be utilized rather than creating new ones.

Soil-4. Where desired for ground cover and erosion control, access routes, firelines, staging areas and other disturbed areas may be scarified and seeded, mulched, and/or covered with slash.

Design Features

61. Purpose: To minimize soil erosion and maintain soil productivity.

Soil-5. Machine piling operations would remove only enough activity-generated slash to accomplish surface fuel reduction needs.

Soil-6. The depth of scattered slash would be the minimum needed to limit soil erosion, so as not to impede understory growth of grasses, forbs and brush.

Mitigation Measures

62. Purpose: To minimize soil erosion and maintain soil productivity.

Soil-7. Prior to and during mechanical treatments, soil moisture conditions would be evaluated and monitored for operability. To prevent soil compaction and displacement, equipment (e.g., masticators, ATVs, UTVs, trucks) would only operate off of constructed roads when soil moisture is low, the ground is adequately frozen, or covered with sufficient snow.

Soil-8. For the retention of long-term soil productivity and to reduce erosion, burning would be implemented when the lower duff layer (decomposed organic matter) in contact with the soil surface is moist enough so a cool burn can be assured to avoid hydrophobic soil conditions.

Recreation

Design Features

63. Purpose: To reduce visibility of treatments.

64. Rec-1. Create a 150-foot visual buffer around campgrounds and picnic areas where no mechanical thinning or piling would occur. Prescribed fire would be allowed to back into these areas.

Mitigation Measures

65. Purpose: To protect and maintain trails within the project area and to minimize impacts on recreation users.

66. Rec-2. If equipment must cross trails and roads, crossing would be minimal, perpendicular to the trail, and rehabilitated after treatment of the area.

67. Rec-3. Use of trails as access routes for heavy equipment should be considered carefully and other routes evaluated to best protect all resources, including recreation.

68. Rec-4. If trails must be used as access routes, they need to be fully reclaimed with sustainable trail practices implemented such as proper cut slope, width for managed use, and drainage features including rolling grade dips, water turnouts, armoring above and below the trail at drainage crossings, water bars, and check darns. Trail reconstruction will be coordinated with the U.S. Forest Service recreation team.

69. Rec-5. Avoid crossing or using motorized and nonmotorized system trails where feasible. If a trail or section of trail is affected, the trail shall be restored to the original condition. All treatment slash and debris would be removed from trails. It is acceptable to make perpendicular trail crossings. Trail crossing locations would be designated and flagged with input from a qualified U.S. Forest Service recreation staff or designated representative. Crossings of existing forest system trails would be restored to pre-project condition after use.

70. Rec-6. Applicable signing would be placed at camping areas, trailheads and along trails to warn Forest visitors of project implementation activities such as tree thinning or prescribed burning along trails. Information may also be provided through the U.S. Forest Service website, news releases, traffic control and signage, or other measures as appropriate.

71. Rec-7. Where possible, schedule work that would limit recreation access such that it does not occur around holidays and weekends. Coordination would occur with any sponsors of recreational special use events to minimize impacts to planned events occurring in the project area during implementation.

72. Rec-8. Where riparian areas are fenced, ensure that these do not block system trails. If they do, provide an easy portal through the fence.

73. Purpose: To reduce visibility of treatments.

74. Rec-9. Stumps will be cut to a maximum of 8 inches within 150 feet of National Forest System trails, and as low as possible in all other distances zones.

75. Rec-10. Paint and markings, such as butt marks, leave-tree and boundary markings within 150 feet of National Forest System trails, roads, and campgrounds would be applied facing away from these areas to reduce visibility. Flagging would be used in these areas, where practical, to mark unit boundaries and should be removed upon project completion.

76. Rec-11. Cut trees flush with trail when they need to be cut on the edge of the trail and road.

77. Rec-12. Disguise route entrances to firelines with rocks, boulders, downed trees, and forest litter to prevent them from being seen, easily accessed and becoming user trails. It should be difficult to access these areas for recreational use.

78. Purpose: Achieve scenic integrity consistent with Forest Plan direction.

79. Rec-13. Activity-generated fuels (slash) created within 100 ft. of NFS trail and roads would be piled outside the 100 ft buffer and/ or burned to be removed within 2 years to manage for a high scenic integrity objective.

Scenery Resources

Best Management Practices

80. Purpose: Communicate project and policy requirements to all parties involved in implementing management activities.

81. Scen-1 A landscape architect or forest scenery specialist would be involved with the treatment unit layout strategy in Sensitivity (Concern) Level 1 areas. The extent of viewsheds from Sensitivity Level 1 areas would be confirmed in the field.

82. Scen-2 When fencing is visible from Sensitivity Level 1 travelways and use-areas, consult Forest recreation staff about its design, e.g., form, color and material.

83. Purpose: To reduce visibility of treatments.

84. Scen-3 When possible, firelines would utilize existing features such as roads and trails (considering stock trails if near the area desired) and natural features (rocks and cliff-faces)

85. Scen-4 Fire control lines would be constructed, wherever possible, to reduce the contrast so that they are not noticeable in the middle and background views.

86. Scen-5 Thinning of trees should have a form and shape that simulates natural patterns and openings and edges blended to minimize visibility of unit edges (such as avoiding straight lines, sharp corners, or geometric shapes).Where feasible, the edges of such treatments should be: tied into existing meadows and openings, follow natural topographic breaks and changes in vegetation, or provide feathering that allows gradual transition into the untreated adjacent forest area (as opposed to an abrupt line).

87. Scen-6 When feasible, treat both sides of open system roads and trails to avoid contrast.

88. Scen-7 Stumps will be cut to a maximum of 8 inches within 150 feet of National Forest System roads, and as low as possible in all other distances zones.

Mitigation Measures

89. Purpose: To reduce visibility of treatments.

90. Scen-8 Mechanical and manual thinning treatments along linear features, such as roads, trails or property lines would be implemented in a manner that does not emphasize straight lines and draw attention to the linear feature.

91. Scen-9 No machine piles within the immediate foreground (300 feet) of sensitive viewpoints.

92. Scen-10 Fire control line construction would only occur where necessary. Any fire control line constructed would be to minimal standard needed to complete prescribed burning.

Cultural Resources

Standard cultural resource protection measures will be implemented to protect Historic Properties (also referred to as archaeological sites or cultural sites) and to ensure No Adverse Effect to Historic Properties. These standard protection measures are identified in Appendix J and Appendix E of the Region 3 Programmatic Agreement (USDA-FS 2010). These standard protection measures have been modified for the purposes of this project. Historic Properties *Listed* on the National Register of Historic Places (NRHP), *Eligible* for the NRHP, or *Unevaluated/Undetermined* for the NRHP will be protected during all project activities. Sites determined *Not Eligible* for listing on the NRHP will be documented but not protected. If previously unidentified cultural materials are discovered during implementation, work will cease in the area until a qualified professional archaeologist is notified and has approved restarting work.

Best Management Practices

93. Purpose: Communicate project and policy requirements to all parties involved in implementing management activities.

94. Heritage-1 Allow project activities within site boundaries, provided a qualified professional archaeologist is present to monitor sites (those Listed, Eligible, or Unevaluated/Undetermined for the NRHP) during and following project activities.

Mitigation Measures

95. Purpose: Protect cultural resources and ensure No Adverse Effect to Historic Properties

96. **Compliance with the National Historic Preservation Act (NHPA)**

97. Heritage-2 No ground disturbance will take place within site boundaries of Listed, Eligible, or Unevaluated/Undetermined sites without SHPO consultation.

98. Purpose: Consistency with Appendix E of the Region 3 Programmatic Agreement (USDA- FS 2010)

99. Heritage-3 Rubber-tired vehicles may cross through sites only on existing roads and must remain within the existing road prism.

100. Heritage-4 Utility Terrain Vehicles (UTVs) and All-terrain Vehicles (ATVs) may cross through sites only on existing roads and motorized trails as long as the vehicles remain within the existing road or motorized trail prism.

101. Purpose: Consistency with Appendix J of the Region 3 Programmatic Agreement (USDA- FS 2010)

102. Heritage-5 Do not use tracked vehicles or other heavy or mechanical equipment within site boundaries.

103. Heritage-6 Do not stage personnel or equipment within site boundaries.

104. Heritage-7 Do not pile logs, trees, and other thinned materials (slash) within site boundaries.

105. Heritage-8 Remove vegetation by hand from within site boundaries.

106. Heritage-9 Do not drag logs, trees, or thinned material (slash) across or within site boundaries.

107. Purpose: Consistency with Forest Plan standards.

108. Heritage-10 Reduce dense vegetation within site boundaries.

109. Heritage-11 Remove dead and down vegetation within site boundaries, especially logs in direct contact with cultural features.

110. Heritage-12 Qualified professional archaeologists will mark sites with white flagging tape or paint for identification during project activities.

Vegetation Thinning Treatments

When manual or mechanical vegetation thinning activities will occur, the following mitigations or combination of mitigations will be followed in addition to those listed above in the *Standard Design Features for all Project Activities within Archaeological Sites* section:

Design Features

111. Purpose: Protect cultural resources and ensure No Adverse Effect to Historic Properties

112. Consistency with Appendix J of the Region 3 Programmatic Agreement (USDA-FS 2010)

Heritage-13 Allow treatments within site boundaries, provided:

a. Cutting is accomplished using hand tools only (chainsaws or cross-cut saws)
b. Trees are felled away from all features

Mitigation Measures

113. Purpose: Protect cultural resources and ensure No Adverse Effect to Historic Properties

114. Consistency with Appendix J of the Region 3 Programmatic Agreement (USDA-FS 2010)

Heritage-14 Allow construction of landing zones and staging areas in 100% surveyed areas, with archaeological monitoring as appropriate to ensure sites are avoided by ground-disturbing activities.

Heritage-15 In areas of less than 100% survey, cultural resources survey and clearance is required prior to construction of landing zones and staging areas.

Prescribed Fire Treatments

Where prescribed burning activities will occur, the following mitigations or combination of mitigations will be followed, in addition to those listed above in the *Standard Design Features for all Project Activities within Archaeological Sites* section:

115. Purpose: Protect cultural resources and ensure No Adverse Effect to Historic Properties

116. Consistency with Appendix J of the Region 3 Programmatic Agreement (USDA-FS 2010)

Heritage-16 No ignition points within site boundaries

Heritage-17 Allow construction of safety zones, helicopter landing and sling sites, staging areas, and additional fire line in 100% surveyed areas, with archaeological monitoring as appropriate to assure sites are avoided.

Heritage-18 In areas of less than 100% survey, cultural resources survey and clearance is required prior to construction of safety zones, helicopter landing and sling sites, staging areas, and additional fire line.

Heritage-19 Site protection measures and fuel reduction treatments will occur prior to implementing prescribed burns.

Heritage-20 Site protection measures and fuel reduction treatments will be monitored by a qualified professional archaeologist.

Heritage-21 Allow prescribed fire to burn through sites with low or moderate fire sensitivity, provided that heavy fuels are removed prior to burning.

Heritage-22 Protect fire-sensitive sites (i.e., sites with combustible features, rock art, rock or cave shelters, or structures comprised of friable stone). Protection measures may include the following:

a. Exclude from project area, OR
b. Use hand line, black line or wet line to prevent the spread of fire into sites
c. Use foam retardant or structural fire shelter directly on fire-sensitive resources to prevent their consumption
d. Ensure that heavy fuels that cannot be removed from within site boundaries are not ignited
e. Implement same protective measures for all future maintenance burns
f. When using aerial ignition, provide pilot with GPS site locations to avoid the sites
g. A qualified professional archaeologist will monitor fire-sensitive sites during prescribed burning.

Road Closure

Where forest road closure will occur, the following mitigations, or combination of mitigations, will be followed, in addition to those listed above in the *Standard Design Features for all Project Activities within Archaeological Sites* section:

117. Mitigation Measures

118. Purpose: Protect cultural resources and ensure No Adverse Effect to Historic Properties

119. Consistency with Appendix E of the Region 3 Programmatic Agreement (USDA- FS 2010)

Heritage-23 Sites adjacent to a proposed road closure will be flagged for avoidance.

Heritage-24 Earth-disturbing closure activities (i.e., earthen berm construction, ripping road tread) may take place within site boundaries only if the Forest and the SHPO agree that there will be No Effect or No Adverse Effect to sites.

Heritage-25 Vehicles and equipment using U.S. Forest Service roads must stay on the road prism in areas that bisect heritage sites.

Heritage-26 No new road construction, reconstruction, or modification of the existing road prism within site boundaries.

Range Resources

Grazing Management Activities & Protection of Allotment Improvements:

Best Management Practices

120. Purpose: Maintain existing rangeland monitoring sites.

Range-1. Existing rangeland monitoring sites would be located prior to treatments. Monitoring sites would not be excluded from treatments; however, sites would not be used for landing areas and slash piles.

121. Purpose: Coordinate management activities with range staff to minimize impacts to rangeland resources.

Range-2. Before treatments occur, consult with district range staff to coordinate pasture use.

Range-3. All water infrastructure (earthen dams, trick tanks, storage tanks, pipelines, drinkers, etc.) should not be removed or excluded from treatments. Any damage to infrastructure due to project implementation activities would be reported to the District and repairs coordinated with relevant District staff.

Range-4. Damage to range infrastructure would be avoided to the extent possible. If there is damage to infrastructure from treatments, it would be restored before the project is completed.

Range-5. Managers of vegetation treatment projects would consult with District range managers to ensure alteration of natural barriers does not allow livestock to circumvent fences and lose the integrity of the pasture or allotment.

Range-6. All pasture gates would be kept closed during the grazing season (May through November).

Range-7. Fence openings created to facilitate any management actions should be closed each day in active grazing areas during the grazing season. (May through November)

Prescribed Burning

Best Management Practices

122. Purpose: Minimize impacts to range infrastructure.

Range-8. Fire and timber personnel would coordinate with district range staff on prescribed burn operations and thinning prior to implementation.

Range-9. Avoid damaging fire-sensitive range infrastructure (corrals, pipelines, water storage tanks, water troughs, fences, and cattleguards) to the extent possible. Methods may include pre-burn fuel removal, fire containment lines around structures, strategic ignition patterns, or other methods. Any damage to infrastructure due to project implementation activities would be reported to the District and repairs coordinated with relevant District staff.

Range-10. Fence lines would be used as burn area boundaries when possible.
Range-11. When and where possible, take advantage of natural barriers and existing roads to limit soil disturbance and construction of new fires lines.

Design Features

123. Purpose: Minimize impacts to rangeland resources.

Range-12. Livestock would be managed to allow for habitat response after project implementation. Allotment pastures would be rested from grazing for a minimum of one year following broadcast burning of that pasture. Prior to livestock being authorized to graze an area that was treated with prescribed burning, interdisciplinary vegetation monitoring would be conducted to determine if plant health and groundcover has recovered sufficiently to support grazing and protect soil.
Range-13. No single pasture within a grazing allotment would be treated with prescribed fire within two consecutive years.

Air Quality and Public Health

Mitigation Measures

124. Purpose: Reduce impacts of prescribed burning to air quality and public health.

Air 1. Burn when fuel conditions are conducive for slow to moderate fire spread in short needle fuel beds. This typically occurs in the early spring, late summer, or fall. Short needle fuel beds occur under mixed conifer that dominates sites on north aspects.
Air 2. Consider burning with relatively good nighttime humidity recoveries (weather conditions decrease fire activity)
Air 3. Prescribed burning will use emission reductions techniques and will be coordinated with the State of New Mexico, in compliance with its smoke management plan, to minimize the effects on air quality. Monitoring would comply with NMED direction.
Air 4. Activities will be planned to meet applicable Federal, State, and local air quality regulations, including protection of Pecos Wilderness Class I Airshed
Air 5. Broadcast burning will only be conducted during accepted weather conditions for wind + ventilation. Pile burning, which is usually conducted in the late fall and winter, may be done during fair or poor ventilation days using a waiver.
Air 6. Burn when weather conditions are predicted to reduce smoke impacts to population centers during ignitions and at least one day following ignitions.

Wildlife Resources

Note: The Biological Assessment and Biological Evaluation use the term Integrated Design Features (IDFs) to refer collectively to the Best Management Practices, Design Features and Mitigation Measures identified here.

Best Management Practices

125. Purpose: Communicate project and policy requirements to all parties involved in implementing management activities.

126. Wild-1 A U.S. Forest Service Biologist would be consulted prior to treatment unit preparation as well as during implementation as necessary to assure these wildlife measures are considered.

Wild-2 If treatments that might disturb nests are planned to occur during nesting season, nests and dens would be located during project preparations before implementation occurs. Procedures for locating the nests and dens would be coordinated with an FS Biologist.

127. Purpose: Compliance with the Endangered Species Act.

128. Wild-3 If any U.S. Forest Service Sensitive Species or Threatened or Endangered species is observed within or near the project area before or during implementation, sufficient protection would be provided in accordance with recovery plans and specific forest, regional and national guidance. Implementation would cease until an FS biologist has been notified, has investigated and has made recommendations. Occurrences would also be documented and recorded in the appropriate databases, such as GIS.

129. Purpose: Meet the project's desired conditions

130. Create and maintain diversity in structure, composition, and age classes across the landscape.

131. Wild-4 Large down logs would not be targeted for crushing or displacement with machinery, but some may be damaged during implementation (e.g., mastication along strategic fuel breaks).

132. Wild-5 Prescribed burning treatments would be implemented to attain low-to-moderate fire severity across the burn area. Implementors would strive to limit high burn severity areas to <10% of each burn unit. Such efforts are expected to create a mosaic burn pattern, with a diversity of fuel consumption and fire intensity.

133. Wild-6 If present, Gambel oaks would be retained by not targeting them for removal during thinning activities, but some may be removed when preparing firelines. To the extent feasible, native shrubs such as wild rose (*Rosa* spp.), mountain mahogany (*Cercocarpus montanus*), Rocky mountain maple (*Acer glabrum*), currants (*Ribes* spp.), and raspberry (*Rubus* spp.) would be retained during thinning activities. Prescribed fire implementation would not target these species for ignition but would be allowed to consume some in a mosaic manner; burning some while leaving others unburned.

134. Wild-7 Where available, at least 3 trees per acre with unique branching, broke-off top, spike-top or multiple tops would be retained, with additional emphasis within 200 feet along cliffs, major ridges and openings. Preferred species for retention would be large pines and firs.

Design Features

135. Purpose: Consistency with Forest Plan direction for vegetation management.

136. Meet the project's desired conditions

137. Create and maintain diversity in structure, composition, and age classes across the landscape.

138. Create and maintain diverse habitat types across the landscape.

139. Wild-8 Leave-islands (thickets or clumps) and openings would be distributed throughout each treatment unit to provide for cover and foraging areas for wildlife species as well as to retain younger age classes. Leave islands would be approximately ¼ to ½ acre in size and approximately 10% of the treatment unit.

140. Wild-9 An average of 3 slash piles (approximately 3 feet high and 10 feet in diameter) per acre would be retained (not burned) except within a 0.25 mile of privately owned structures, where at least 1 slash pile (at least 3'h x 10'd) per acre would be retained. To provide cover and nesting habitat, location preference would be near (within ¼ mile) water sources and away from infrastructure such as roads, campgrounds, buildings, private land, etc.

141. Wild-10 The retention and release of aspen, oaks, Scouler's willow and the release of the largest ponderosa pines and largest Douglas fir would be facilitated by focused thinning immediately surrounding these species. Focused thinning would remove the conifers under and over the canopy of these species and ideally/approximately an additional 30 feet beyond. This would be done in coordination with an FS Biologist.

142. Wild-11 Trees selected for retention in project-created openings would be suited for open stand conditions, such as pines. Firs would not be selected for retention in openings, as they are more susceptible to sun-scorch and wind-throw in open conditions.

143. Wild-12 To the extent practical, cover would be maintained to provide connectivity corridors for big game as well as furbearers. This would include leave-islands and stringers that would generally connect across the landscape. Screening (areas that have not been thinned with sufficient vegetation cover to block viewing long-distances) would be used, especially along roads. Screening would be designated beyond the primary road corridor to allow for fire management.

144. Wild-13 In pinyon-juniper (PJ) woodlands, depending on the habitat type (PJ persistent, PJ savanna, PJ grassland, etc.), treatments would be implemented to promote pinyon jay habitat (mast-producing trees, nesting cover and recruitment) and connectivity. At least 15% of mature and over-mature mast-producing stands of pinon-juniper and oak zones within each treatment area would be maintained.

Mitigation Measures

145. Purpose: Consistency with Forest Plan direction for vegetation management.

146. Meet the project's desired conditions.

147. Create and maintain diversity in vegetative structure, composition and age classes across the landscape.

148. Create and maintain diverse habitat types across the landscape.

149. Wild-14 Tree felling would be directed away from trees designated to be retained. Machinery would avoid contact with trees designated to be retained. Smaller diameter trees (<12 inches dbh) that are designated to be retained would be the most vigorous/healthy of the site.

150. Wild-15 The largest coarse woody debris (downed logs) would be retained. Emphasis would be on the retention of wood in the largest size classes and in decay classes 1, 2, and 3, but also representing a range of decomposition classes if available.

a) Coarse woody debris including downed logs, varies by seral stage, , follow Forest Plan guidance.
b) The largest diameter logs available would be retained; at least 12 inches diameter, with preference for logs over 15 feet in length, but at least 8 feet long.
c) If these standards cannot be met with current downed logs, additional down logs would be supplemented by felling trees that meet the above standards and leaving them on site.
d) Where fuelwood gathering would be planned, downed logs retained to meet this standard would be painted (side away from roads and trails) along length.
e) Fuelwood permits would specify that trees and logs with paint would not be cut or removed.

151. Wild-16 During thinning and prescribed fire prep, snags would not be cut unless they pose a safety hazard; for example, within falling/striking distance of high human residency time areas such as staging areas.

152. Wild-17 If the desired number of snags per acre is not available for retention, snag creation would be considered. If determined as necessary to meet the desired conditions, snags would be created through methods such as girdling.

153. Wild-18 Snags that are cut for this project (e.g., safety) would be left after felling to contribute to downed log habitat.

154. Wild-19 Prescribed fire ignition would not target large down logs and ignition would not occur at the base of snags; however, these features may ignite if fire creeps to them while burning occurs.

155. Wild-20 Burn piles would be located a sufficient distance from large snags and large down logs (where deficient) to minimize the risk of ignition to these habitat features during pile burning operations.

156. Wild-21 Piles would be placed away from healthy, mature aspen (which have thin bark) to minimize negative impacts to them. An exception would be in cases where mature aspen are unhealthy to an extent that the stand is unlikely to remain sustainable without management, therefore, fire could be used to encourage the stand to re-sprout.

157. Wild-22 Leaners (trees/snags that have fallen at an angle of approximately 15 to 45 degrees from the ground, often held up by surrounding trees or rocks) would be retained and

avoided, where available, and/or could be created, which provide plucking posts (goshawks) and subnivean (under snow) access.

158. Purpose: Consistency with the Migratory Bird Treaty Act.

159. Create and maintain diverse habitat types across the landscape.

160. Wild-23 When possible, treatments (such as thinning, burning, mastication, road work, etc.) would be implemented outside of nesting season to minimize impacts to migratory birds, especially in brush/shrub areas, riparian areas, along cliff faces, and rock features. Typically, breeding season is from April 15 through August 15. If treatments have to occur during the breeding season, treatments would be designed to minimize cumulative effects to migratory species during that specific breeding season, and a 150-foot buffer would be established around observed active songbird nests, which would not have thinning treatments.

161. Wild-24 Trees would be inspected for nests and cavities prior to cutting/removal. Trees with an observed nest (bird, squirrel, etc.) or cavity would be retained during thinning and not targeted during burning, along with the trees immediately surrounding (interlocking crowns, provides shade or cover to nest) the nest tree to maintain the existing cover and shade. If a den is known or discovered, vegetation that provides cover surrounding the den and cover corridors from the den leading out of the project area would be retained during thinning and not targeted during burning. Prescribed fire implementation would not target these trees for ignition, but some may be burned.

162. Wild-25 An FS biologist would be notified upon discovery of a large stick-type nest. From February through September, noise-producing project activities within ¼ mile of the nest would be temporarily paused, at least until the nest is investigated by an FS biologist who can provide recommendation for proceeding.

163. Wild-26 There would be no intentional killing, harassment, removal or handling of animals, nests, eggs, dens, etc.

Mexican Spotted Owl

Mitigation Measures

164. Purpose: Consistency with the 2012 Mexican Spotted Owl Recovery Plan

165. MSO-1 The 2012 Mexican Spotted Owl Recovery Plan would be implemented where applicable.

166. MSO-2 Before implementing management activities, the U.S. Forest Service ID Team would be consistent with the Regional Mexican Spotted Owl Habitat Treatment and Implementation Guidance.

Within MSO Protected Activity Centers (PACs)

167. MSO-3 Coordination with USFWS would occur when planning and implementing site-specific thinning within MSO PACs.

168. MSO-4 No treatments would occur in the PACs during the breeding season, unless a U.S. Forest Service biologist confirms that the PAC is not occupied or that breeding is not occurring.

169. MSO-5 Where needed to meet objectives, trees less than 9 inches in diameter maybe cut in PACs, but work would be focused in areas outside of the PACs.

170. MSO-6 A 100-acre Core Areas would be designated in each PAC, burning would be allowed to enter into Core Areas only if they are expected to burn at low intensity with low severity effects. Coordination with USFWS would occur for any active ignitions needed within the core areas to protect habitat from high intensity burning.

171. MSO-7 A fire management burn plan would be prepared for broadcast burning applications within PACs, employing low intensity fire.

172. MSO-8 Timing and type of burning would be coordinated with wind direction, topography, time of year, and distance to PACs to reduce smoke impacts.

173. MSO-9 Hardwoods, downed woody debris, snags and other key habitat variables would be retained, unless when their removal would be compatible with MSO habitat management objectives, documented through reasoned analysis.

174. MSO-10 Fuelwood gathering units for the public would not be designated in PAC boundaries. Fuelwood gathering by the public would not be promoted in PAC boundaries.

Within MSO Recovery Habitats

175. MSO-11 All trees greater than 16 inches dbh, as well as hardwoods, large down logs, large trees and snags would be retained unless posing a hazard. If snags must be removed due to hazards, cutting should be avoided from March through September. Cut snags would remain on site to contribute to large, downed wood debris habitat.

176. MSO-12 Hardwoods, downed woody debris, snags and other key habitat variables would be retained, with an emphasis in managing for large hardwoods.

Within Nest/Roost Habitats

177. MSO-13 Before implementing management activities in areas that have been identified as recovery nest/roost habitat U.S. Forest Service staff will review site conditions and project activities for compliance with MSO management direction, including 2022Forest Plan management approach; FW-ATRISK-MA-1. This process will include the following considerations:

1. Field verification of existing stand conditions (e.g., tree species and forest structure, but potentially also landscape context and operability)
    a) If the vegetation conditions do not warrant all or part of the proposed action, or it would be operationally infeasible, then the action could be modified or dropped. For example, if a stand does not have high density of small-diameter trees, it may not be appropriate to implement a thinning treatment but may still be appropriate to conduct prescribed burning.
    b) If the vegetation conditions generally warrant the proposed action and there are not operational limitations, then implementation may proceed contingent on consistency with MSO management direction and guidance below.
2. Based on observed site conditions, confirm whether the area has potential to meet recovery nest/roost conditions.
    a) If an area identified as draft recovery nest/roost habitat is unlikely to develop nest/roost habitat conditions, the area may be removed from the recovery nest/roost candidate map and project implementation may proceed without additional design criteria for MSO. A minimum of 25% of the mixed-conifer forests in the SFMLRP area must be managed to maintain or promote desired conditions for nest/roost habitat.

b) If the area meets or has potential to meet the desired recovery nest/roost habitat conditions (see 2012 Recovery Plan, Appendix C, Tables 2 and 3), then evaluate whether implementation is consistent with forest plan standards and guidelines for managing MSO habitat and the analysis in the project EA and BA.

3. If conditions vary within a stand proposed for activities, including situations where part of the stand is designated as draft recovery nest/roost habitat, then the proposed activities may be modified to follow a. and b. above. For example, if a stand contains an INREV polygon identified as draft recovery nest/roost habitat, the proposed action may be modified within the INREV polygon to promote attaining nest/roost habitat characteristics but implemented as proposed in the rest of the stand for fuel reduction.

178. MSO-14 During site review or implementation, INREV polygons not previously identified as nest/roost habitat may be added to the recovery nest/roost candidate map if they are found to meet or show potential to meet nest/roost habitat conditions. Project implementation on such sites will then require the review described above.

Northern Goshawk

Mitigation Measures

179. Purpose: Consistency with Northern Goshawk management guidance in the current Forest Plan

180. NOGO-1 Guidance from the SFNF Forest Plan would be reviewed and followed which includes the Northern Goshawk Management Guidelines.

181. NOGO-2 Suitable habitat within the project area, including ½ mile beyond the project boundary, would be surveyed to R3 Survey Protocol prior to project implementation of thinning and burning treatments that could impact the species.

182. NOGO-3 A Goshawk Post-Fledging Area (GPFA) of approximately 600 acres and a Goshawk Home Range (GHR) of at least 6,000 acres would be designated around active northern goshawk nests and territorial goshawks. A Goshawk Nest Area (GNA) of at least 30 acres would be designated around active northern goshawk nests and each GPFA would have at least three nest areas and three nest replacement areas within it, for a minimum total of 180 acres of nest areas in each GPFA. These designated areas would be delineated by a FS Biologist to include the best available habitat within the immediate area.

183. NOGO-4 A Limited Operating Period (LOP) would be in effect from March 1 through September 30 within ¼ mile of active GNA and GPFA boundaries. If the nest site cannot be determined, but territorial adult northern goshawks are present, the LOP would be within ¼ mile of an averaged activity center or the PFA. This LOP would not exclude work from occurring but would restrict what types of work could occur and would consider noise level, human presence, duration, proximity to known species occurrence, topography, etc. to remain within the current effect determinations. Project activities proposed to be implemented during the LOP would be reviewed and agreed to by a U.S. Forest Service Biologist.

184. NOGO-5 Vegetation Management guidelines for goshawk habitats described in the Forest Plan would be followed. Emphasis would be to maintain or create uneven-age stand conditions and retain live reserve trees, snags, downed logs, and woody debris levels throughout woodland, ponderosa pine, mixed conifer and spruce-fir forest cover types. Old age trees would be managed so as much old forest structure as possible is sustained over time across the landscape. A mosaic of vegetation densities (overstory and understory), age classes and

species composition would be maintained or created across the landscape. Non-uniform spacing of trees and clumping would be promoted.

185. NOGO-6 At least two groups of trees per acre with a minimum diameter of 12 inches would be retained, with a minimum of 3 trees per group (USDA 1992).

186. NOGO-7 Prescribed burning would be implemented to ensure that the entire 6,000-acre home range would not be burned in one year. Human presence while implementing prescribed burning will be minimized within 100 yards of known active nest areas. A burn plan would be prepared for broadcast burning applications within GPFA boundaries to employing low intensity fire. Timing and type of burning would be coordinated with wind direction, topography, time of year, and distance to GNA boundaries to reduce smoke impacts, risk of crown fire, consumption of nest trees and displacement of adult goshawks.

187. NOGO-8 The ground surface layer would be maintained in satisfactory condition to minimize soil compaction and maintain hydrologic and nutrient cycles. (See design features for Hydrology/Riparian Resources and Soils.)

188. NOGO-9 Riparian vegetation would be managed to maintain or achieve good condition. Riparian vegetation, stream banks and channels would be protected. (See design features for Hydrology/Riparian Resources.)

189. NOGO-10 Emphasis would be to maintain snags that are 18 inches or larger dbh and 30 feet or larger in height, downed logs that are 12 inches in diameter and at least 8 feet long, and woody debris is 3 inches or larger on the forest floor.

190. NOGO-11 Canopy cover would be maintained according to goshawk area designation and stand type,
and would consist of 40% to 60% or more canopy cover in landscapes outside GPFA, and 50% to 70% or more canopy cover within GPFA and GNAs.

191. NOGO-12 Piling of debris (slash) would be avoided in goshawk designated areas, where possible. If needed, within GNAs piling would be by hand and would not utilize grapple or dozer piling, while outside of GNAs, piling would be done by hand or grapple to minimize soil compaction, and forest floor and herbaceous layer disturbance.

192. NOGO-13 Fuelwood gathering units for the public would not be designated in PFA boundaries. Fuel- wood gathering by the public would not be promoted in PFA boundaries.

References:

U.S. Forest Service

2010 *First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities Among New Mexico Historic Preservation Officer and Arizona State Historic Preservation Officer and Texas State Historic Preservation Officer and Oklahoma State Historic Preservation Officer and the Advisory Council On Historic Preservation and United States Department Of Agriculture Forest Service Region 3.*

Appendix E – Standard Consultation Protocol for Routine Road Maintenance, Road Closure, and Road Decommissioning Projects on National Forests in New Mexico

Appendix J – Standard Consultation Protocol for Large-Scale Fuels Reduction, Vegetation Treatment

Appendix D. Monitoring Plan

Santa Fe Mountains Landscape Resiliency Project Monitoring Plan

The Santa Fe Mountains Landscape Resiliency Project (SFMLRP) would use a condition-based approach to restore desired conditions at the fine scale, mid-scale, and landscape scale. Project implementation would be monitored during and after completion of each phase (thinning, piling, burning, etc.) to allow for condition-based management as described in the Environmental Assessment (EA). Monitoring would be done by qualified individuals, such as a certified silviculturist, hydrologist and/or biologist as applicable, and reviewed by an interdisciplinary team of specialists, including those just listed.

The monitoring plan outlined below includes the monitoring activities required to support the Final Environmental Assessment for the SFMLRP project, including legal monitoring obligations. These high-priority U.S. Forest Service project monitoring activities will be complemented both by existing Forest Service monitoring activities and multi-party monitoring.

Examples of existing Forest Service monitoring include Forest Health Protection aerial detection surveys for bark beetle activity, regular monitoring of range sites, watershed condition monitoring, and wildlife monitoring, including MSO population monitoring. A comprehensive Forest-wide monitoring implementation plan will be developed with Forest Plan for the Santa Fe National Forest.

A Multiparty Monitoring Strategy is also currently in development with partners through the Greater Santa Fe Fireshed Coalition. Current priorities for this Strategy include monitoring forest structure and composition, fuels and fire behavior, avian diversity and abundance, water quality, and air quality. Some of these monitoring activities, including the avian monitoring, would be developed as citizen science initiatives for public engagement and transparency.

All monitoring conducted for the SFMLRP will be based upon current best available science.
As implementation proceeds, the U.S. Forest Service will work with internal and external partners to help ensure that knowledge and expertise is leveraged to address key management questions. Monitoring practices will be documented to ensure that processes are replicable through time and changing personnel.

The U.S. Forest Service will share the results of SFMLRP monitoring with partners and the general public at an annual science review meeting, with support from our partners at the Greater Santa Fe Fireshed Coalition.

Table. D-1. Monitoring Plan

Monitoring Question	Monitoring Activity	Methodology	Timing/Frequency	Action to be taken if results do not meet minimum compliance levels or if impacts are not mitigated as planned
Where are treatments needed and what treatments are most appropriate?	Pre-implementation monitoring	Field reconnaissance and vegetation surveys, protocols dependent on forest characteristics within the treatment area (e.g., homogeneity of stand conditions) and the availability of existing data (e.g., common stand exams).	Before treatment prescriptions are written	N/A
Are projects adhering to specifications, including implementation of silvicultural prescriptions, design features, best management practices, and mitigation measures?	Compliance monitoring	Site inspections	Daily to weekly while operations are active	Adjust treatments to ensure compliance
What restoration treatments are being applied in the project area?	Implementation monitoring	Site inspections, reporting in FACTS	Post implementation, tracked annually	N/A
How are thinning and burning treatments impacting MSO PAC occupancy?	Effectiveness monitoring- MSO PAC Occupancy	Recovery Plan	Pre and Post at PACs at intervals to be determined in coordination with USFWS	Adjust treatments (e.g., reduce thinning/burning). Before implementation during the breeding season, monitoring must confirm that the PAC is not occupied, or breeding is not occurring. Pre- and post-treatment monitoring would occur early so the impacts of treatments can be understood before proceeding with treatments in additional protected activity centers.
How are thinning and burning treatments impacting PAC and Nest/Roost habitat? Are these habitats moving towards desired conditions?	Effectiveness monitoring- Nest/Roost habitat monitoring and validation	U.S. Forest Service CSE protocol and FVS modeling	Pre and Post in Nest/Roost habitats at intervals to be determined in coordination with USFWS	Adjust treatments (e.g., reduce thinning/burning)
How are thinning and burning treatments impacting goshawk territory occupancy?	Effectiveness monitoring- Goshawk Territory Occupancy	Forest Plan direction and NOGO Survey Protocol	Pre and Post (approximately 2 and 10 years) at territories	Adjust treatments

Monitoring Question	Monitoring Activity	Methodology	Timing/Frequency	Action to be taken if results do not meet minimum compliance levels or if impacts are not mitigated as planned
How are thinning and burning treatments impacting goshawk territory habitat?	Effectiveness monitoring- Goshawk territory habitat	Site visits to document post-treatment conditions and movement towards desired conditions (criteria to be determined by Forest Service biologists)	Pre and Post (approximately 2 and 10 years) at territories and potentially suitable habitat	Adjust treatments
What are the cumulative effects of moderate and high severity burning on soil, water quality and range resources?	Cumulative Watershed Effects Monitoring in places with where there has been moderate or high severity burning (places devoid of vegetative groundcover post-burning)	- Use BARC map to find/prioritize areas of concern - Use BMP protocols to evaluate impacts to water quality - Look at soil burn severity - Look for living roots and the potential for re-growth - Look at residual duff and needle-cast	- If a unit was burned in the spring, monitor in September, prior to the proposed fall burn. - If a unit was burned in the fall, monitor in March or April, prior to a proposed spring burn. - Monitor groundcover, forage recovery and resiliency prior to grazing burned pastures.	Postpone burning within the same watershed until ground cover has been adequately recovered. Postpone grazing until vegetative ground cover and forage are recovered and thriving (and for *at least* one year after a pasture is burned).
What are the effects of implementation on cultural resources?	Post-Implementation Cultural Resource Assessments	SFNF Archaeological Site Form Update	During or Post-Implementation	Inform Forest Archaeologist; Cease management activity if adverse effects are observed; SHPO & Tribal consultations and Damage Assessments

This page intentionally left blank.

Appendix F. Strategy for Avoiding Cumulative Watershed Effects

The following strategy was deemed necessary to avoid adverse cumulative watershed effects (CWEs) by the proposed action and grazing, while also considering the timing and potential effects of successive proposed treatments within a single watershed. These activities have the most potential to cause adverse CWEs because they both can reduce vegetative ground cover. Vegetative ground cover significantly diminishes the adverse effects of the proposed action by slowing, infiltrating, and filtering runoff. Figures F.1 and Figure F.2 display the strategy described in text below.

For a watershed of any size, a broadcast burn unit of any size, and once a broadcast burn unit has been implemented[6]-

- Fire managers will communicate vegetation burn severity to watershed staff; were there any areas of *moderate or high severity*?
    - *If not, no action.* Prescribed fire can continue within the watershed as soon as a burn window allows; the assumption being that ground cover has not been significantly and adversely affected; is expected to positively respond to the nutrients released by the burn and will become more effective at filtering and infiltrating water (by the next monsoon season).
    - *If the prescribed fire resulted in an area of moderate or high vegetation burn severity*, and the area is thought to be large enough to potentially have significant effects- an IDT of fire/fuels, watershed and range staff will go to the field to investigate. A BARC map may be used to better understand the extent of potential impacts. Areas of moderate or high severity will be targeted, especially those near stream channels. Evidence of impacts to water quality (e.g., ash flows, rills, debris flows) will be sought out. Residual ground cover and the potential for needle-cast will be assessed. The potential for winter precipitation and monsoon precipitation will be considered; what is the likelihood winter precipitation will support vigorous growth of ground cover in the spring? What is the likelihood the monsoon season will be very active? What is the risk of erosion during the monsoon season?
        - If there is evidence of impact to water quality *or* soil productivity, *or* there is concern for the regeneration of ground cover- consider delaying burning within the same watershed. Re-evaluate the burn unit after a wet season; resume burning in the watershed once enough ground cover has been established to eliminate or minimize cumulative adverse impacts.
        - If there are no impacts *and* ground cover regeneration is highly likely, consider burning additional blocks within the watershed. Because impacts to water quality are most likely to occur during the monsoon season, the potential for cumulative watershed effects by spring burns will be more difficult to assess than those by fall burns; *therefore, be more cautious when making the decision to burn in the spring (following a prior fall burn).*
- Per the range design feature; where prescribed fire overlaps with a pasture, grazing would be deferred for *at least* one year. Monitoring of forage volume and vigor would determine when grazing would commence. Assessment would be accomplished by an interdisciplinary team of fire/fuels, watershed and range staff.

---

[6] The proposed action applies the following annual limits to implementation:

- Maximum prescribed fire unit would be 2,000 acres
- Annual maximum prescribed fire treatment area would be 4,000 acres (in two sessions; one spring burn and one fall burn, in any one watershed.)
- Annual maximum vegetation thin would be 750 acres

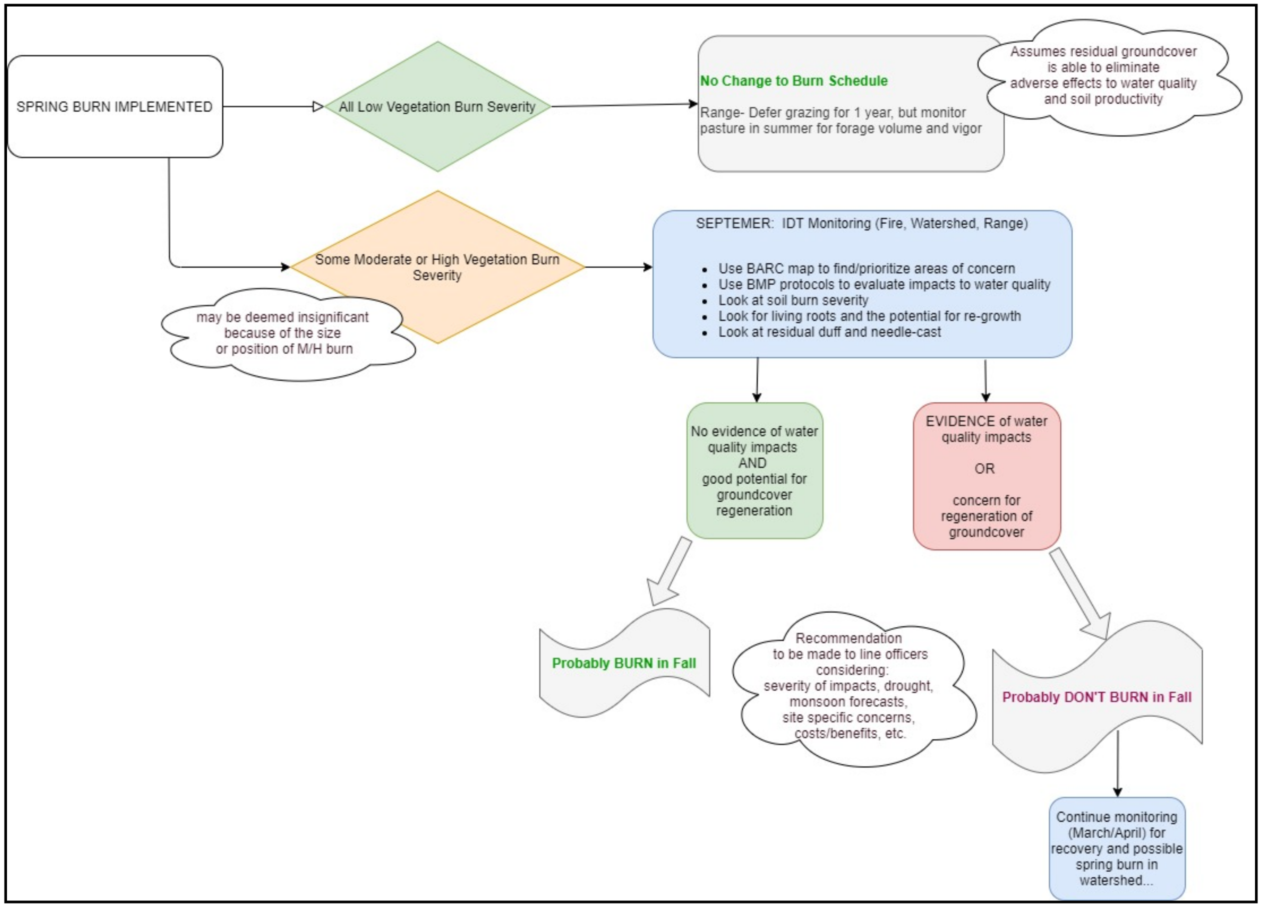


Figure F.1. Fall burn strategy for avoiding cumulative watershed effects.

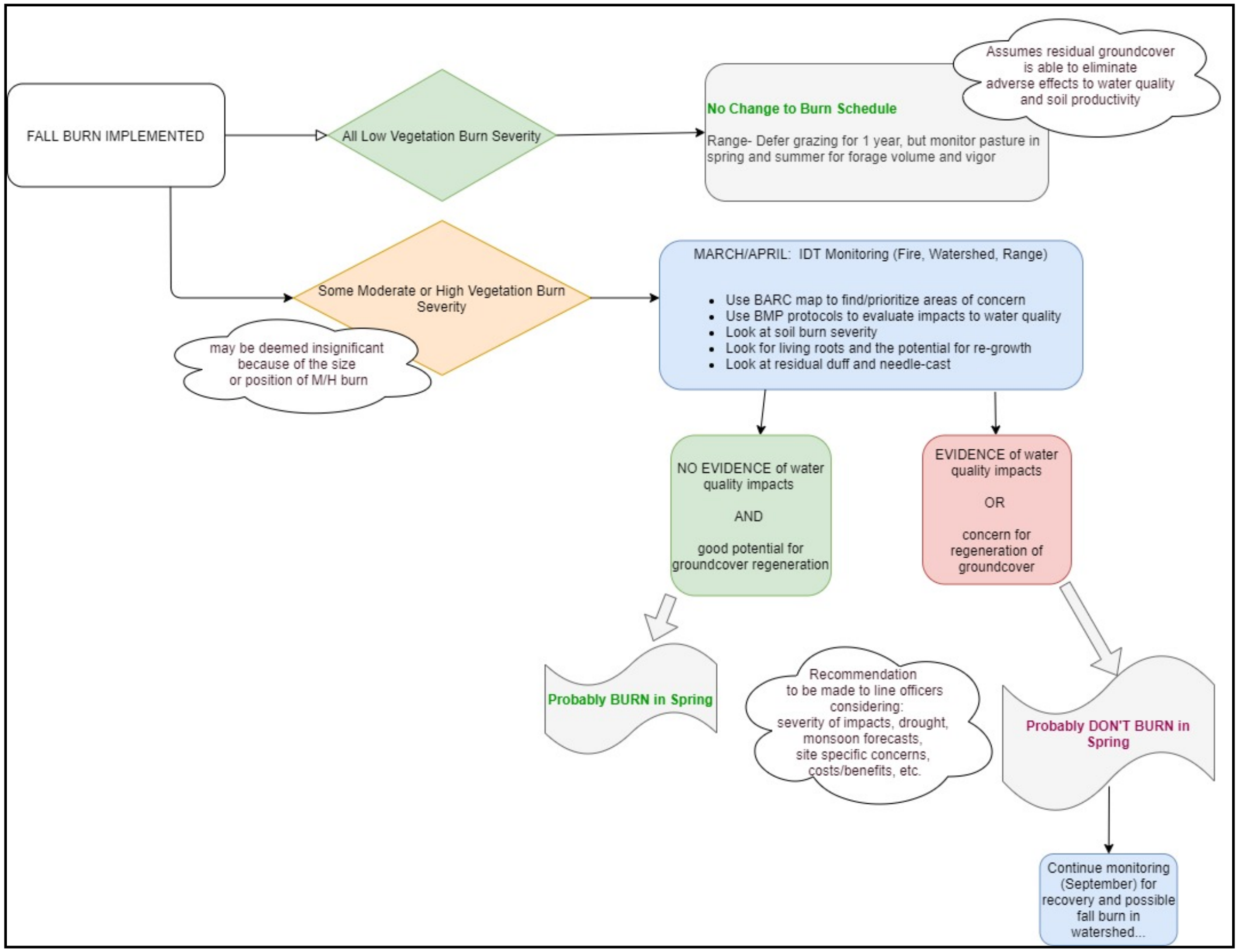


Figure F.2. Spring burn strategy for avoiding cumulative watershed effects.

This page intentionally left blank.

Appendix G Public Comment Period Content Analysis and Response

United States Department of Agriculture

Santa Fe Mountains Landscape Resiliency Project

Draft Environmental Assessment

Public Comment Period Content Analysis and Response

Forest Service Santa Fe National Forest

Table of Contents

List of Tables

This page intentionally left blank

1.0 Introduction

The U.S. Department of Agriculture, Forest Service (Forest Service) developed a public involvement strategy in compliance with National Environmental Policy Act (NEPA) regulations in order to educate the public and interested parties about the Santa Fe Mountains Landscape Resiliency Project (SFMLRP or project), receive their input, and identify public concerns. The process consists of the following public involvement milestones: public scoping period, release and review of the draft environmental assessment (EA), public comment period for the draft EA, release of the final EA, and publication of the Decision Notice/Finding of No Significant Impact.

The scope of this report is to summarize and respond to public comments received for the draft EA released for public review in September 2021.

2.0 Draft Environmental Assessment Public Comment Period

A public notice was placed on the Forest Service website for this project on Monday, September 13, 2021, notifying the public of the comment period for the Santa Fe Mountains Landscape Resiliency Project Draft Environmental Assessment.

The Santa Fe National Forest held two virtual public meetings during the public comment period for the Santa Fe Mountains Landscape Resiliency Project Draft Environmental Assessment, on Wednesday, October 6, 2021, and Thursday, October 14, 2021.

The Forest Service received 123 public comment letters during the draft EA public review period. Input received in writing helps the Forest Service identify environmental concerns and/or impacts to be addressed in the Final EA, new design features to be considered for resource protection, and potentially new or different project alternatives. The Final EA incorporates responses to all substantive public comments received on the draft EA.

3.0 Methods for Public Comment Collection and Analysis

The Forest Service has reviewed all comments received through October 29, 2021, and these are summarized in this report.

The Forest Service collected comments using three methods: an online Internet form via the Forest Service's Comment and Analysis Response Application (CARA), email, or regular postal mail.

Original letters were encouraged to be mailed to the following address:

Santa Fe National Forest, Española District Office
18537 US 84/285, Suite B
Española, NM 87532

All comments received by the Forest Service were uploaded to the Forest Service's CARA. The Forest Service Interdisciplinary Team downloaded all public comments from CARA to review and code each comment letter (Appendix H). At the completion of comment coding, CARA was used to create reports that categorized the various comment types and to synthesize the submitted information presented within this report.

Throughout the comment entry and coding process, the Interdisciplinary Team completed quality assurance/quality control (QA/QC) checks to ensure that all comments were entered correctly and accurately.

3.1 Summary of Public Comments

In total, 123 comment letters were received during the draft comment period beginning September 29, 2021 and ending October 29, 2021. Individuals and organizations that submitted comment letters are listed in Appendix I.

The Forest Service identified 444 individual comments contained within the comment letters (excluding duplicates). A summary of the public comments received and organized by concern, issue, or resource topic is presented in Table 3-1, in order from the greatest number of comments received to the least number of comments received. It is possible that comments addressed multiple topics; therefore, comments may be included in multiple topics below.

Table 3-1. Summary of Draft Environmental Assessment Comments Received, by Topic

Topic	Number of Comments
Soil, Water, and Riparian Resources	6
Air Quality, Wildfire, Wildland/Urban Interface	70
Vegetation Communities	26
Wildlife, Special-Status Species	33
Cultural Resources	1
Public Involvement	25
NEPA Process	5
Climate Change	6
Grazing	4
Inventoried Roadless Area	16
Visual Resources	4
Comments Not Relevant to the Decision	*248*
Total	**444**

4.0 Public Comments Received

4.1 Project Support

Two comments (contained in letter numbers 12 and 14) support the Proposed Action as presented in the draft EA.

Response: Thank you for your comments and your support for the Santa Fe Mountain Landscape Resiliency Project. We appreciate your interest and participation in the planning process.

4.2 Comments Not Relevant to the Decision

There were 248 comments that were, in whole or in part, not relevant to the decision process because the comment was non-substantive or out of scope. The Forest Service has will not develop responses to these non-substantive or out-of-scope comments. The portions of these comments that were substantive and relevant are discussed below in Section 4.3.

4.3 Project Concerns and Responses

Topic 1: Soil, Water, and Riparian Resources

Theme 2-1: Soil

Three comments (contained in letter numbers 90, 91, and 131) expressed an interest in further analysis of the potential effects of vegetation thinning and prescribed fire on soil ecology, including impacts such as soil erosion and loss of resilience. One comment expressed concerns over the potential loss of soil nutrients from runoff and use of prescribed fire. Another comment outlined the risks to soil integrity from erosion and to water quality for runoff during seasonal rains as a consequence of the thinning treatments.

REPRESENTATIVE COMMENT(S):

- *The plan targets 20-30% of the Canada Forest as a potential thinning area, which burning will affect not only the La Canada area, but all of Santa Fe, and our watershed. As has been evidenced in other parts of the state, the burns kill not only understory, small and medium sized trees and scorch larger trees, but will also damage or destroy the soil's nutrients and capacity for recovery. You propose to burn every 5-15 years, a time period that current ecological science says won't be long enough to allow either understory or soil ecology to recover, especially during a 100-year drought. […]*

Theme 2-2: Water and Riparian Resources

Three comments (contained in letter numbers 114 and 130) expressed an interest in further analysis of the potential effects of vegetation thinning, prescribed fire, and herbicide use for vegetation management on riparian resources and water quality. One comment expressed concerns regarding the toxicity of herbicides and their potential adverse effects on aquatic and riparian species. Another comment questioned whether the proposed treatments were in alignment with natural disturbance regimes within the project area, and whether the treatment were adequately based on current knowledge of riparian habitat.

REPRESENTATIVE COMMENT(S):

- *Given the stresses of a warming and drying climate, it is hard to understand why herbicides would be applied that may have even low toxicity levels to fish and other aquatic species, or that may potentially damage native vegetation species during application. Exhibit 7. The Forest Service here fails to provide any meaningful analysis or demonstrate the herbicide use will not have adverse effects on aquatic or riparian species. The omission is a fatal flaw in the analysis and at bottom demonstrates the uncertainty inherent in the agency's proposed actions. The Forest Service states that "The abundance of conifers in riparian corridors is uncharacteristically high at the expense of deciduous trees and shrub-herb vegetation. Exotic woody species are undesired within all riparian ERUs and currently include localized populations of Russian olive (Elaeagnus angustifolia), Siberian elm (Ulmus pumila), and other invasives.*
  " EA at 139. However, the table "Outlook for Likely Effects of Proposed Action" states, in regard to exotic woody species: "No effect. Project is not likely to decrease the current amount of exotic woody species." EA at 50. More clarity is needed as to whether utilizing herbicides will have the desired effect, or not.

- *The proposed action for riparian restoration suggests a mindset that considers it possible to redesign the ecosystem through fairly heavy-handed human ecological engineering. This approach creates challenges in even identifying the potential cumulative impacts, much less analyzing them. Given the uncertainty of the riparian treatments proposed, and the extent that such treatments will be in opposition to natural trends related to our warming and drying climate, the best approach is very light-handed, targeted and strategic restoration that works with current climatic trends instead of against them. The analysis and planning to accomplish this should be done in the context of an EIS.*

RESPONSE:

Potential impacts to soil, water, and riparian resources are discussed within SFMLRP EA Section 3.6, Watersheds and Hydrology, and Section 3.7, Riparian Resources. A summary of these potential impacts from the No Action Alternative and Proposed Action can be found in EA Section 2.4, Comparison of Alternatives (see EA Table 2.9). The reader is referred to EA Section 3.6, where impacts to soil productivity, watershed flow, and water quality are disclosed. Furthermore, EA Section 3.7 discusses impacts to seral state diversity, riparian woody regeneration, coarse woody debris, and other impact indicators associated with watershed health. Additional information regarding how project activities under the Proposed Action would be implemented can be found within EA Appendix C, Design Features, Best Management Practices, and Mitigation Measures.

Appendix C describes best management practices, project design criteria, and mitigation measures that would be implemented to mitigate potential adverse impacts to soil, water, and riparian resources and guide implementation to achieve desired conditions. Water-2 through Water-4 are intended to maintain water quality; Water-5 and Water-6 are intended to minimize noxious weed spread and reestablish native vegetation; Water-7 through Water-11 and Rx-1 through Rx-10 are intended to minimize soil erosion, promote soil productivity, and maintain water quality; Thin-1 though Thin-10 are intended to maintain water quality, minimize soil erosion, maintain and reestablish vegetation, and maintain streambank stability; Soil-1 through Soil-8 are intended to minimize soil erosion and maintain soil productivity.

The difference between reference conditions and desired conditions are explained within the EA in Section 1.3. Desired conditions use historical ecology within the context of historic range of variability in each vegetation type, in addition to social and economic considerations, as a template for management action. Reference conditions provide a best estimate of a functional and sustainable system and are a useful basis for developing desired conditions while accounting for uncertainties (e.g., climate change). Restoration may not necessarily return an ecosystem to its former state, because contemporary constraints and conditions can cause it to develop along an altered trajectory (Clewell et al. 2005; Pilliod et al. 2006).

EA Section 3.7.1, under Riparian Resources, describes conifer abundance in riparian areas within the SFMLRP project area as substantially exceeding the characteristic canopy cover of the ecological reference model identified in the Santa Fe Terrestrial Ecological Unit Inventory (U.S. Forest Service 1993). Overall seral state diversity is moderately departed from desired conditions with an excess of late seral plant communities and lack of riparian obligate regeneration. The abundance of conifers in riparian corridors is uncharacteristically high at the expense of deciduous trees and shrub-herb vegetation.

Exotic woody species are undesired within all riparian ecological response units (ERUs) and currently included localized populations of Russian olive (*Elaeagnus angustifolia*), Siberian elm (*Ulmus pumila*), and other invasives. The Proposed Action has been revised to no longer include herbicide application. However, as provided in design feature Plant-7, if deemed necessary for successful riparian restoration, herbicides would be applied to non-native species within riparian areas in a manner that is consistent with the *Santa Fe National Forest Invasive Plant Control Project Record of Decision* (SFNF Invasive Plant Control Project ROD) (U.S. Forest Service 2018b).

EA Section 3.2.2, under Vegetation Communities, describes limits to sizes of trees that may be removed. The Proposed Action is not anticipated to have a substantial effect upon old growth (as defined by the Santa Fe National Forest Land Management Plan)or large trees within the project area. The Proposed Action includes a "diameter cap" of 16 inches diameter at breast height (dbh) for "forest species" and 12 inches dbh for "woodland species." Given these limits, no large tree would be removed by thinning or mastication operations.

Topic 2: Air Quality, Wildfire, Wildland/Urban Interface

Theme 2-1: Effects of Smoke

Twenty-five comments (contained in letter numbers 9, 23, 28, 37, 43, 44, 46, 47, 51, 52, 62, 77, 85, 92, 98, 101, 107, 111, 116, 121, 122, 123, 126, 130, and 134) expressed concern that smoke resulting from prescribed fire may impact air quality and consequently adversely impact public health.

REPRESENTATIVE COMMENT(S):

- *Ten years ago, the Santa Fe region had exceptionally clean air. Today, with the amount of prescribed burn smoke in the air, which has increased yearly, the public health is being substantially impacted according to local physicians. The most damaging aspects of breathing smoke is inhaling the tiny particulates known as "PM 2.5". These fine particulates affect lung function and can cause eye and nasal symptoms, adversely affecting our immune systems and increasing the risk of heart attack and cancer. (Doctors and Scientists Against Wood Smoke Pollution)*

Theme 2-2: Forest Natural Range of Variability

Four comments (contained in letter numbers 8, 60, 72, and 111) expressed an interest in further analysis of the effects of prescribed fire and vegetation thinning on forest structure and natural regeneration. Comments expressed concerns that the treatments would result in a departure from the natural range of ecosystem variability typically found in unmanaged, natural forests.

REPRESENTATIVE COMMENT(S):

- *Another justification for this Project is eradicating the so-called "over-abundance" of trees and vegetation. However, by removing the vast majority of trees and understory and by repeated burning, you ensure that understory will never return to support a natural and healthy forest. Furthermore, our local watersheds have been severely damaged due to draught caused by climate change, and this Project will cause further damage to these vulnerable areas.*

Theme 2-3: Wildfire Effects

Thirty-six comments (contained in letter numbers 6, 7, 10, 12, 15, 16, 18, 26, 35, 37, 49, 54, 61, 62, 73, 74, 76, 77, 79, 81, 84, 87, 89, 93, 107, 110, 114, 115, 117, 118, 120, 122, 124, 129, 130, and 131) requested further analysis regarding the efficiency of prescribed burns at reducing the likelihood of catastrophic wildfires and expressed concern over prescribed burning intervals outlined in the EA.

REPRESENTATIVE COMMENT(S):

- *The FS uses outmoded research justifying prescribed burns and thinning every 5-15 years, whereas more recent research argues that treatment should be applied only every 55 years. (Baker 2017) Intentionally burning forests this frequently creates dry, barren and sterile forests lacking ecological integrity and diversity. Trees help cool the forest floor and retain moisture for a healthy forest ecosystem.*

Theme 2-4: Wildland/Urban Interface

Five comments (contained in letter numbers 6, 18, 96, 102, and 130) questioned whether alternative measures such as enforcing strict building codes or thinning around structures could be used to prevent catastrophic wildfires without having to use prescribed burns and vegetation thinning as planned in the Proposed Action.

REPRESENTATIVE COMMENT(S):

- *If the purpose is to protect houses built into the surrounding forest it should be addressed by enforcing strict codes to fireproof those buildings with 100 foot or more mediation of their surroundings, and fire-resistant construction. Looking at Paradise California and seeing building built too close together burning down and yet the trees next to them surviving in some cases indicates the problem was not the fire but the lack of fire preparation in that community. […]*

- *One of the major reasons for this Project is to prevent wildfires from burning our homes. However, it has been proven that active thinning around structures renders them safer than cutting down the forest. In 2016 a study revealed that such treatments are useless for decreasing the amount and intensity of fires in Western forests and may even increase fire impact. Also, the open land resulting from the removal of the majority of trees increases wind speeds and enhances destructive fire behavior. In fact, thinned and open forests are drier and more flammable. Debris left from logging and thinning causes wildfires of greater intensity. Simple observation of "treated" areas demonstrates that forest ecology has been greatly harmed.*

RESPONSE:

In 2009, the USDA Forest Service established policy direction for climate change considerations in project-level National Environmental Policy Act analysis (U.S. Forest Service 2009). The policy calls for addressing climate change through two types of climate change effects analysis in National Environmental Policy Act documentation when appropriate.

The effect of a proposed project on climate change (greenhouse gas emissions and carbon cycling). Examples include short-term greenhouse gas emissions and alteration to the carbon cycle caused by hazardous fuels reduction projects and avoiding large greenhouse gas emissions pulses and effects to the carbon cycle by thinning overstocked stands to increase forest resilience and decrease the potential for large scale wildfire.

The effect of climate change on a proposed project. Example: effects of expected shifts in rainfall and temperature patterns on the seed stock selection for reforestation after timber harvest and effects of decreased snow fall and increasing earlier snow run-off."

Concerning Number 1. The information provided in the EA Section 3.8, Air Quality and Climate, and in the Fuels and Wildfire Behavior – Air Quality – Climate Change and Carbon Sequestration specialist report discloses the potential impacts from the No Action Alternative and Proposed Action resulting from smoke and compares the estimated impacts to national and state criteria air pollutants. The EA and specialist report also analyze greenhouse emissions by showing several possible current condition and future wildfire and prescribed burning scenarios. Using this information, the public can compare and evaluate potential emissions among the alternatives. The SFMLRP EA and specialist report disclose the potential changes to stored carbon and how the implementation of the Proposed Action would move to stabilize carbon storage over time, compared to no action (see EA Sections 3.8.1 and 3.8.2).

Concerning Number 2. Due to approximately 100 years of fire suppression and past management practices, the ecosystems in the proposed project area are now far outside the natural range of variability for these forest ecosystems (see EA Section 1.4, Existing and Desired Conditions). Global warming or climate change effects are increasing the risk of severe drought and damaging wildfires. The information provided in the SFMLRP EA and in the specialist report addresses the effects of climate change to the proposed project area and how the implementation of the Proposed Action would move the area towards meeting the Santa Fe National Forest Land and Resource Management Plan's goals, objectives, and desired conditions. Moving towards or meeting desired conditions would increase ecosystem resilience and resistance to unnaturally intense, damaging wildfires and increase public safety in the wildland/urban interface (WUI).

Effects of Smoke. The SFMLRP EA and specialist report address the Clean Air Act regulatory framework and how human health would be protected during implementation of the project as required by law. EA Section 3.8.2, under Air Quality and Climate, and the specialist report also show how the adverse health effects of wildfire fire would be reduced by implementation of Proposed Action prescribed burning. The U.S. Forest Service would take measures to manage smoke impacts resulting from prescribed fire following design features Air-1 through Air-6 (see EA Appendix C). Prior to implementing a prescribed fire, a prescribed fire plan would be written to follow the New Mexico Smoke Management Program. Prescribed fires would be carefully evaluated to consider smoke dispersal into nearby communities surrounding the Santa Fe Mountains. As a result, the effects on air quality from prescribed fire would be short term and localized near the prescribed fire area.

Forest Natural Range of Variability. Due to approximately 100 years of fire suppression and past forest management practices, the proposed project area's ecosystems are now far outside the natural range of variability (or variation). In addition to unnaturally dense forest stands and heavy fuel load accumulation, global warming or climate change effects are increasing the risk of severe drought and damaging wildfires. The information provided in the EA and in the Fuels and Wildfire Behavior – Air Quality – Climate Change and Carbon Sequestration report addresses the effects of forest thinning and prescribed burning and how implementation of the Proposed Action would move the area towards meeting the Santa

Fe National Forest Land and Resource Management Plan's goals, objectives, and desired conditions. Implementation of the project and continued future frequent prescribed burning and naturally ignited wildfires would move the area towards meeting desired conditions.

Wildfire Effects. The EA and specialist report show that currently, most of the proposed project area is at high risk of large, high-intensity wildfires that would significantly damage forest ecosystems, wildlife, homes, and other structures in the WUI, and adversely affect watersheds and water quality. Because most of the proposed project area currently is far outside the natural range of variability, wildfires would burn at unnaturally high intensity and crown fire over broad areas would kill thousands of acres of trees. The EA and specialist report show that implementation of the proposed project would move the area towards meeting forest ecosystem and fuels desired conditions and support the frequent use of fire at intervals and intensity that would approximate the natural range of fire intervals.

Wildland/Urban Interface. The USDA Forest Service is not the agency having jurisdiction over building codes and fire codes affecting private property or other non-National Forest System lands. However, Forest Service policy calls for the agency to take actions that would increase the protection of private property, such as homes and other structures, in areas where wildfires have the potential to damage or destroy buildings adjacent to agency lands. The EA and specialist report disclose how implementation of the proposed project would decrease wildfire intensity near structures.

Topic 3: Vegetation Communities

Theme 3-1: Carbon Sequestration

Three comments (contained in letter numbers 3, 102, and 111) requested further analysis regarding the impacts of the Proposed Action on carbon release and storage as a result of the vegetation thinning and prescribed fire treatments.

REPRESENTATIVE COMMENT(S):

- *The EA does not adequately address the issue of carbon release and storage. An analysis must include the total carbon release, including the fossil fuels needed to carry out the treatments, the effect of soil compaction, the loss of sequestration potential by reducing the number of trees, the carbon released by slash burning, and the regrowth rates, among other effects.*

Theme 3-2: Forest Ecology

Twenty-three comments (contained in letter numbers 3, 13, 18, 69, 85, 96, 106, 114, 115, 122, 124, 129, and 133) expressed concerns about the vegetation treatments outlined in the Proposed Action, including the use of herbicides to eliminate invasive plant species. Another comment expressed concern over the proposed tree thinning plan and questioned whether the diameter at breast height selected for thinning should be reduced.

REPRESENTATIVE COMMENT(S):

- *While plants may survive the impacts of a broadcast burn, they are less likely to survive a pile burn, or being buried under wood chips, or an incidental herbicide application. Known occurrence of state listed endangered plants include wood lily (Lilium philadelphicum var. andinum) and yellow lady's slipper (Cypripedium parviflorum var. pubescens). In addition, the treatment areas are mapped within 5 miles of known populations of the federally listed Holy Ghost Ipomopsis (Ipomopsis sancti-spiritus).*

Although the species is currently only known to occur along the Holy Ghost Canyon Road, it may occur elsewhere on the Santa Fe National Forest, in the appropriate habitat. Was potential habitat analyzed for Holy Ghost Ipomopsis in the project area? Surveys for state and federally listed plants are essential prior to any treatment in the habitat of these sensitive resources, so they can be avoided if found.

- *Among my concerns is the plan to do so much drastic thinning which seems to be geared to lumber production in that it initially wanted to take trees with a 24-inch diameter. Reducing that to 16 inches still takes older more fire-resistant trees and would leave the smaller diameter and less valuable trees. The amount of thinning would leave the ground open to far too much drying conditions which with our present global warming projections would be far worse for the forest making the remaining trees more susceptible to damage from wind, drought, and disease.*

RESPONSE:

The Proposed Action has been revised to no longer include herbicide application. However, as provided in design feature Plant-7, if deemed necessary for successful riparian restoration, herbicides would be applied to non-native species within riparian areas in a manner that is consistent with the SFNF Invasive Plant Control Project ROD (U.S. Forest Service 2018b).

Carbon Sequestration. See the Santa Fe Mountains Landscape Resiliency Project: Fuels and Wildlife Behavior – Air Quality – Climate Change and Carbon Sequestration specialist report in project record. EA Table 2.9 provides comparison of the No Action and Proposed Action and addresses carbon sequestration as related to air quality and climate. EA Section 3.8.2 explains the Proposed Action would increase ecosystem resistance and resilience that could result in carbon sequestration beyond the 10- to 15-year project duration. Even though practices such as thinning and prescribed fire may release carbon in the short term, they focus growth and sequestration for the future on trees that are at lower risk and/or are more resilient to disturbance. Previous research in southwestern ponderosa pine forest has demonstrated that a restored condition that is maintained by regular surface fire can store more carbon than a fire-suppressed condition when the effects of unplanned wildfire are incorporated (Hurteau 2017). More information on carbon sequestration can be found in EA Section 3.8.1.

Forest Ecology. The analysis related to vegetation communities (EA Section 3.2) addresses the impacts of the Proposed Action as related to forest and woodland structural distribution and species composition, anticipated impacts related to common insects and disease agents, preservation and promotion of southwestern white pine, and the preservation and promotion of old growth. The impact analysis focuses on issues listed at the beginning of EA Section 3.2, Vegetation Communities, which include silvicultural concerns, forest health, upland vegetation, old growth, and MSO and northern goshawk habitats.

A brief description of common insects and disease agents found within the project area is provided on EA Section 3.2.1, and the anticipated effects, related to forest health as well as insects and disease, under the Proposed Action are presented in EA Section 3.2.2. The decrease in stocking resulting from thinning treatments and use of prescribed fire is anticipated to reduce resource (water, nutrients, and light) competition among trees, which would allow for improved resistance and resiliency from the impacts of agents such as bark beetles and defoliators (Kegley 2011; Livingston 2010; Pederson et al. 2011; Randall 2010a, 2010b, 2012). For example, healthier trees are more able to defend themselves from bark beetles, and more able to bounce back from defoliation events. See EA Section 3.2.2 for additional analysis on this topic.

The impacts from the No Action Alternative and the Proposed Action are presented in the draft EA under "Treatment Effects" in Section 3.2.2 as well as within the Vegetation Effects Analysis specialist report (see project record). The Vegetation Effects Analysis goes into greater detail on both alternatives, including relevant scientific literature and vegetation growth and yield modeling of a sampling of local vegetation within the project area.

Lumber production. The vegetation treatments that constitute the Proposed Action of the draft EA are described in Section 2.1.2. These treatments are vegetation thinning (within and outside of Mexican spotted owl [MSO] protected activity centers), prescribed fire treatments (within and outside of MSO protected activity centers), as well as riparian restoration treatments. The proposed thinning treatments may be conducted by hand (chainsaws) and with machinery (masticators), while excavators and other specialized equipment may also be used to move and treat fuels. The draft EA also states that "Forest products would not be generated as a part of this project with the exception of fuelwood where conditions allow and do not conflict with resource objectives." In other words, apart from fuelwood, no other product would be offered or sold. This includes sawtimber, lumber, posts, poles, chips, biomass, and so on. Additionally, no new roads are proposed as part of this proposed project. In fact, the draft EA details that roughly 1.5 miles of Forest Road 79W would be gated and closed (EA Section 2.1.2).

Southwestern White Pine. The Vegetation Effects Analysis specialist report (see project record) addresses the anticipated effect upon southwestern white pine. Within this report the silvicultural approach to southwestern white pine management is described (i.e., retain as much as possible or feasible), and the outlook for southwestern white pine is described, explicitly, for the No Action Alternative, and generally for the Proposed Action as a shade-intolerant and fire-tolerant tree species.

The historical fire regimes that support southwestern white pine habitat were varied across this species' range, the dendrochronological record clearly shows that mean fire return interval (MFI) was significantly lower (more frequent) than current conditions. This is the result of over a century of fire exclusion (Looney and Waring 2013). Local evidence from the Sangre de Cristo Mountains show that the MFI was 12.4 years pre-fire exclusion and was dominated by mixed-severity fire behavior. Fire exclusion in the Sangre de Cristo Mountains (project area) began around 1842 (Margolis and Barmot 2009). Research suggests that while fire exclusion has led to an increase in the absolute density of southwestern white pine (Danzer et al., 1996; Kaufmann et al., 1998), its relative abundance to other tree species has declined (Dieterich, 1983; Iniguez et al., 2008; Sakulich and Taylor, 2007). In addition, mature southwestern white pine trees are adapted to survive low-severity fire and are not adapted to withstand stand-replacing fires. Stand-replacing fires are becoming ever more common in mixed-conifer forests; especially where stand densities have increased as a result of fire exclusion. Unlike other high-elevation five-needle white pines which have an animal seed dispersal mechanism (i.e., the Clark's nutcracker), the apparent lack of an animal-based dispersal mechanism suggests that the southwestern white pine may recover significantly slower in post-wildfire settings (Coop and Schoettle, 2011).

While published scientific literature on the effects of silvicultural treatments on southwestern white pine is limited, diameter-limited thinning (as proposed in this project) was shown to have a favorable effect on basal area growth post-treatment (Gottfried, 1992). Basal area growth and release in response to thinning treatments is known to increase overall tree vigor. Seedling growth of southwestern white pine was also shown to be significantly higher in managed stands and white pine responded positively to canopy openings (Goodrich et al., 2016). Goodrich also suggested that regeneration of white pine should avoid areas with thick duff/litter layers for better success.

The proposed action would not allow cutting of trees over 16" dbh and would therefore be in line with Forest Service silvicultural recommendations for white pine blister rust management – that is, retain all white pines of good form and vigor "crop tree quality" (Conklin et. al 2009). In fact, this exceeds the recommendation as all mature white pines will be retained (16" dbh cap) regardless of form and vigor. In smaller diameter classes, the silvicultural practice proposed is to retain as much white pine as possible / feasible. Given that thinning will likely increase basal area growth in white pine, and the strategy is to retain all mature white pine and as much as feasible in the smaller diameter classes, it is reasonable to infer that the proposed action should have a positive effect of white pine health within the project area. Damage (direct effect) to mature white pines because of the proposed action is unlikely as small-diameter thinning (tree falling) would not damage overstory trees and mature white pines are resistant to the effects of low-severity fire. Introduction of prescribed, low-severity fire along with mechanical thinning would also be beneficial for the regeneration of southwestern white pine by increasing light and preparing a bare mineral seedbed (Goodrich et al., 2016). The proposed action would also restore mixed conifer stands to their historical fire disturbance regime and fire suppression has been shown to have negative effects on white pine abundance.

Diameter Caps. Section 2.1.2 of the draft EA details the thinning diameter limits of the Proposed Action. Specifically, the limits are 16 inches dbh, 12 inches diameter at root collar (drc) for junipers and two needle pinyon pine, and 9 inches dbh within MSO protected activity centers. These diameter caps are all tiered to the U.S. Forest Service recovery plan for the Mexican spotted owl. These diameter limits are maximum upper limits and site-specific diameter limits would be determined by the conditions-based approach described in EA Section 2.1.1. In other words, no tree larger than 16 inches dbh (9 inches dbh within a protected activity center) or 12 inches drc would be removed as part of thinning operations, and depending upon existing conditions, smaller unit-specific diameter limits would likely be employed.

Please see the draft EA for discussion regarding many topics including habitats and species/habitat design features (Appendix C). The project is anticipated to have potential beneficial and negative short-term impacts and long-term beneficial impacts including habitat resiliency. The project is conditions-based and includes design features that allow for the site-specific management of multiple species habitats if they are present in each treatment unit. As such, this allows for managers to determine the actions needed prior to and during implementation in order to protect and improve the site-specific habitats, including but not limited to occupancy, seasonal timing restrictions, flag and avoid, etc. A discussion of potential impacts to the Holy Ghost ipomopsis (HGI) has been added to EA Section 3.4, Threatened and Endangered Species. The naturally occurring population of HGI is located more than 5 miles from proposed treatments and introduced HGI are located more than 4 miles from proposed treatments. Potential impacts to HGI would be included in the project biological assessment report. An analysis of HGI habitat requirements and potential impacts from the Proposed Action has been added to the EA (Section 3.4.1) to address public comments. Additionally, pre-implementation habitat assessment and HGI protection measures have been added to the design feature list in EA Appendix C.

Topic 4: Wildlife, Special-Status Species

Theme 4-1: Wildlife Habitat

Twenty-eight comments (contained in letter numbers 7, 20, 33, 45, 83, 86, 102, 108, 125, 130, and 131) questioned whether the draft EA adequately analyses the impacts of vegetation thinning and prescribed burning on wildlife habitat, including avian communities, beavers, bobcats, and bears.

REPRESENTATIVE COMMENT(S):

- *Perhaps my biggest complaint with the Environmental Assessment is that it uses studies that support the Action alternative and ignores opposing studies. The "desired condition" is sparse trees, no canopy, and no understory. There is evidence that this is not the historical or natural state of a forest. Using fire scars to construct historical fire conditions has limitations that are not addressed. Intense fires do not leave burn scars; the trees are killed. The size and number of* *plot samples affect the conclusions; data must be interpreted with those parameters in mind. Studies (e.g., by Dr. Chad Hanson) show that Mexican spotted owls benefit from areas of intense fire and are harmed by thinning and prescribed fires. The EA defines high severity fires more broadly than is generally used, thus overstating its potential. Studies also show that thinned forests often burn more intensely and move more rapidly than unthinned ones. Fire models corroborate this finding.*

- *We are writing to comment on the proposed Santa Fe Mountains Resiliency Project. A project of this magnitude demands, at a minimum, a full & rigorous Environmental Impact Study to determine its comprehensive effects on 1) the health of the forest as a whole, including soil health and the critical mycorrhizal fungi network, which promote communication and nutrient sharing among trees. 2) ALL the wildlife in the forest (not just listed species!). Birds' nests occupied in the Spring by eggs and/or nestlings when many prescribed burns occur also count.3) The health of the riparian corridors and the Santa Fe Watershed as a whole.4) The health and quality of life of the human population in the area.5) Regional Weather patterns and climate change.*

Theme 4-2: Special-Status Species

Five comments (contained in letter numbers 79, 106, 114, 124, and 130) questioned whether the draft EA adequately contemplates the impacts of vegetation thinning and prescribed burning on special-status species habitat, including Mexican spotted owl and Grace’s warbler.

REPRESENTATIVE COMMENT(S):

- *May significantly affect species listed or critical habitat designated under the Endangered Species Act, in particular Mexican spotted owl. The Forest Service states "According to the species sensitivities described in the 2012 MSO Recovery Plan (USFWS 2012), activities of the Proposed Action may affect MSO. Impact-causing elements of the Proposed Action include noise disturbance (e.g., operation of heavy machinery), removal of suitable nesting or perching trees or snags, and increased anthropogenic activity-related disturbance (e.g., increased vehicular traffic, human activity) (USFWS 2012). These disturbances have the potential to lead to change in MSO behavior or flush them from perches, daytime roots, and nests. MSOs are known to have high site fidelity in established territories, and short-term impacts may disrupt normal behavioral patterns, such as breeding, foraging, etc., and may not be avoidable. If disturbances and associated changes in behavior occur, this could lead to increased vulnerability to heat-related stress and predation, or lead to nest abandonment and reduced reproductive success (U.S. Forest Service 2021c).*

RESPONSE:

Please see the Draft EA Section 3.4, Threatened and Endangered Species, and Section 3.5, Flora and Fauna, for discussion of impacts from the proposed project on wildlife species and their habitats as well as special-status plants. EA Appendix C lists design features, best management practices, and mitigation measures intended to mitigate impacts to federally listed species, Forest Service management indicator species, and migratory birds. The project is anticipated to have potential beneficial and negative short-term impacts and long-term beneficial impacts including habitat resiliency. For impact on weeds please see the SFNF Invasive Plant Control Project ROD (U.S. Forest Service 2018b) for the Santa Fe National Forest for analysis and disclosure of potential impacts.

Habitat management does not focus on only one species. The treatments proposed in this project would maintain a diversity of habitats and improve habitats for the diverse range of species found in the project area, include those asked about (beavers, bobcats, bears), and many others, including Mexican spotted owl, migratory birds, plants, etc. See the draft EA for general wildlife habitat discussions. Beaver would benefit from treatments that improve riparian hardwood vegetation. Bobcats would benefit from improved prey availability following improved prey foraging because of thinning and burning increasing grass and forb availability and diversity. Bears are generalists and would benefit from improved foraging opportunities. Other indicator species such as pinyon jay will be considered when managing habitat under the conditions-based approached used in this EA. We understand that wildlife is important for helping to manage forest ecosystems.

Topic 5: Cultural Resources

Theme 5-1: Impacts to Cultural Resources

One comment (contained in letter number 96) questioned whether the draft EA adequately contemplates the potential for heavy equipment to adversely impact cultural resources.

REPRESENTATIVE COMMENT(S):

- *Masticators create erosion and roads other destructive means and are truly hideous. Indian and pioneer tracks started our road systems and I have seen evidence in Black Canyon of old homestead roads that current equipment has used.*

RESPONSE:

The Santa Fe National Forest recognizes the potential for heavy equipment to adversely impact cultural resources as discussed in EA Section 3.11, Heritage Resources. It is anticipated that there would be no adverse effects on archaeological resources as a result of implementing design features Heritage-13 through Heritage-16 (see EA Appendix C). Rather, these resources would benefit from vegetation treatments due to reduction of high-severity wildfire risk.

Cultural resource inventories of the project area have been and will continue to be completed by professional archaeologists as needed to properly identify cultural resources before project implementation. Additionally, an ethnographic study of the project area has been completed. The Forest Service has also conducted tribal consultation and collaborated with traditional rural communities to further understand, identify, and acknowledge traditional cultural uses within the project area. Standard cultural resource protection measures will be implemented to protect Historic Properties (also referred to as archaeological sites, cultural sites, or cultural resources) and to ensure No Adverse Effect to Historic Properties.

Topic 6: Public Involvement

Theme 6-1: Request for Contact Information

Two comments (contained in letter numbers 14 and 24) asked to be kept informed of future developments related to this project and asked for agency contact information.

REPRESENTATIVE COMMENT(S):

- *I would like to be given the contact information to some of the people that will be running the projects on the ground. I would like to know which areas that are in the Los Alamitos Canyon general Area will happen and what will the scope be.*

Theme 6-2: Scoping, Stakeholder Input, and Comment Period

Twenty-three comments (contained in letter numbers 41, 45, 61, 75, 79, 84, 87, 95, 96, 98, 102, 106, 110, 113, 114, 124, 126, and 130) expressed concerns related to public input, including the scoping process and the draft EA comment period. Comments advocated for additional public outreach in the form of meetings held in the surrounding communities. Several comments stated that the initial 30-day comment period was too brief due to the size and complexity of the document. Other comments asked for additional opportunities for stakeholder input during the project scoping phase, prior to publishing the draft EA.

REPRESENTATIVE COMMENT(S):

- *The Forest Service has not really included the public in the analysis process. The Forest Service has not given sufficient notice of project comment periods. A number of commenters stated in their scoping comments that they did not know about the comment period in time to write thorough comments. The Forest Service only presented science at public meetings that was in accordance with its own perspective. The Forest Service did not allow the public to view any of the over 5,000 public scoping comments online or even in person at Santa Fe National Forest headquarters. Freedom of Information Act (FOIA) requests are often fulfilled by the Forest Service months or even years after the request is made and often past the time that the FOIA request will be useful to the requester.*

- *The public has been insufficiently included in the planning stages. I only found out about this large burn proposed just in the last week (10/1/2021). These are public lands that we as citizens are all a part of. Why aren't more people aware of this? […]*

RESPONSE:

The Forest Service includes the public in the planning and refinement of a project. This was done with the scoping period in June and July 2019, and the draft EA comment period in September and October 2021. The scoping and comment periods are 30 days as required by law to give ample time to read, digest, and formulate a response to the documentation issued by the Forest Service. Each of these periods came with two public meetings for the public to ask questions and as a tool to help with presenting the information in the draft environmental assessment. The comments received are used in developing and finalizing the environmental assessment. Scoping and comment period information was sent out via multiple outlets. These included the Santa Fe National Forest website, official press releases, the local papers, and through social media.

Meeting presentations were provided by the Forest Service to local tribes and the Fireshed coalition. EA section 1.7 and chapter 4 describe public involvement and tribal consultation during the scoping, draft EA development and public comment periods. The SFNF will ensure ongoing consultation with Native American groups and other traditional communities during each implementation phase for the proposed treatment units.

Topic 7: NEPA Process

Theme 7-1: Scale of Analysis and Opposing Science

Four comments (contained in letter numbers 108, 113, and 114) expressed concern that the analysis lacked sufficient site- or project-specific detail. In addition, some comments expressed concern that opposing scientific views had not been adequately considered. Other comments suggested that the impacts of the proposed project be analyzed in an environmental impact statement.

REPRESENTATIVE COMMENT(S):

- *This lack of information is likely the best evidence available that this project needs to be analyzed via EIS rather than EA. See Southeast Alaska Conservation Council, et al. v. U.S. Forest Service, 443 F. Supp. 3d 995 (D. Alaska 2020) (rejecting an EIS for a project with a similar lack of information).*

- *Given the fallacies of using historic conditions as a reference for desired conditions and the uncertainty that treatments will maintain or restore ecological integrity in the context of climate change and likely forest conversion scenarios, the Forest Service must reevaluate its assumptions about its proposed vegetative treatments, especially in regard to restocking success and species composition. Significant controversy exists as to the need for such treatments given the improper use and reliance on historic conditions. In fact, there is a high likelihood based on the aforementioned studies that some areas will not regenerate and will instead result in conversion to different vegetative groups. The Forest Service should consider whether attrition due to climate change will reduce tree densities sufficiently so that thinning treatments are not needed to meet the SFMLR Project purpose. There appears to have been an increased amount of tree mortality in the SFNF in recent years. NEPA mandates that the agency address this controversy and science that contradicts agency assumptions in an EIS.*

Theme 7-2: Conditions-Based Approach

One comment (contained in letter number 114) questioned whether the use of the conditions-based approach was appropriate to address the environmental impacts of the Proposed Action and whether it adequately complies with NEPA requirements.

REPRESENTATIVE COMMENT(S):

- *The Forest Service reliance on Condition-Based Management violates NEPA. A. Background NEPA is "'our basic national charter for protection of the environment.'" Center for Biological Diversity v. United States Forest Serv., 349 F.3d 1157, 1166 (9th Cir. 2003) (quoting 40 C.F.R. § 1500.1 (2019)). In enacting NEPA, Congress recognized the "profound impact" of human activities, including "resource exploitation," on the environment and declared a national policy "to create and maintain conditions under which man and nature can exist in productive harmony." 42 U.S.C. § 4331(a). […]*

RESPONSE:

Analysis was done using the best available science to the Forest Service. We do not have complete information on every acre of the landscape. However, we do have enough information to make very informed and guided decisions about the landscape. The conditions-based approach allows flexibility and lets us take into consideration and account for variances in information and adapt to the environmental conditions that are existing on each specific site. Prior to any implementation, the Forest Service would identify and determine site-specific treatment units and prescriptions based on site-specific conditions. As landscape and on-the-ground conditions vary, the appropriate tools and information is applied to reach the desired results. The process used is described in more detail in the EA Section 2.1.2. Furthermore, EA Appendix C provides a comprehensive list of design features, best management practices, and mitigation measures that would be reviewed and applied, as resource conditions warrant, as part of the implementation process.

Topic 8: Climate Change

Theme 8-1: Greenhouse Gases Emissions and Carbon Storage

Six comments (contained in letter numbers 79, 114, 125, 127, 129, and 130) expressed concern that the proposed project would contribute to increasing the release of greenhouse gases to the atmosphere and reduce forest carbon sequestration due to removal and burning of trees.

REPRESENTATIVE COMMENT(S):

- *The area's forests are likely currently acting as carbon sinks, meaning they are storing more carbon than they are emitting. Science makes clear that the proposed action will likely worsen climate emissions by removing trees that are currently fixing carbon, turning them into wood products (which results in a significant loss of that carbon fixed in wood), and leaving a landscape with fewer or no trees and (eventually) seedlings that fix far less carbon than mature forests for decades if not centuries. It is crucial not only to protect old and mature forests, but to ensure early and mid-seral stands can grow into new those conditions, especially since the Forest Service has admitted, regarding mature forests in Alaska, such forests "likely store considerably more carbon compared to younger forests in this area (within the individual trees themselves as well as within the organic soil layer found in mature forests)." (U.S. Forest Service 2016, 3-14).*

- *While uncertainty remains around climate change mitigation strategies, it is well-known that carbon sequestration by trees and forests have the potential to positively impact climate change. Unfortunately, the SFMLRP does the opposite by cutting and burning our forests, causing carbon to be released into the atmosphere. While I applaud the Santa Fe National Forest for reducing the size of the trees cut from diameters of 24" to 16", a sixteen-inch diameter Ponderosa is over 150 years old. It will continue to contribute to carbon sequestration for hundreds of years. If cut and burned it may not be replaced due to climate change. A young tree will not store carbon for close to one hundred years. Thus, when we "thin" our forests of mature trees we are killing all life on our planet. The Forest Service must place a priority on land management which promotes forest Carbon storage.*

RESPONSE:

In 2009, the USDA Forest Service established policy direction for climate change considerations in project-level National Environmental Policy Act analysis (U.S. Forest Service 2009). The policy calls for addressing climate change through two types of climate change effects analysis in NEPA documentation when appropriate.

1. The effect of a proposed project on climate change (greenhouse gas emissions and carbon cycling). Examples include short-term greenhouse gas emissions and alteration to the carbon cycle caused by hazardous fuels reduction projects and avoiding large greenhouse gas emissions pulses and effects to the carbon cycle by thinning overstocked stands to increase forest resilience and decrease the potential for large scale wildfire.

2. The effect of climate change on a proposed project. Example: effects of expected shifts in rainfall and temperature patterns on the seed stock selection for reforestation after timber harvest and effects of decreased snow fall and increasing earlier snow run-off." The EA for the Santa Fe Mountains Landscape Resiliency Project met the requirements of NEPA in its analysis of Air Quality and Climate (section 3.8).

Addressing climate change and its impacts to our land, people, and resources is at the forefront of the Nation's concerns as demonstrated through recently issued Executive Orders (14008, 14057, and 14072) and subsequent climate adaptation strategies for the USDA (USDA 2021) and for the Forest Service (USDA FS 2022a), and through the development of the FS Wildfire Crisis Strategy (USDA FS 2022b). The newly revised Santa Fe National Forest Land Management Plan (Plan, 2022) shaped its desired conditions and other plan components to support the forest vision, "to restore fire and resiliency to forest landscapes, provide clean and abundant water, and to honor and strengthen ties to the land." Climate change was considered throughout the development of desired conditions and plan components, as well as served as both a part of the affected environment and as a "driver and stressor" (agent of change) within the plan's EIS. These guiding documents shape and inform management practices and objectives across our public lands.

Concerning Number 1. The information provided in the EA Section 3.3, Fire and Fuels and Section 3.8, Air Quality and Climate, as well as in the Fuels and Wildfire Behavior - Air Quality - Climate Change and Carbon Sequestration specialist report discloses the potential impacts from the no action alternative and Proposed Action resulting from smoke and compares the estimated impacts to national and state criteria air pollutants. The EA and specialist report also analyzes greenhouse emissions by showing several possible current condition and future wildfire and prescribed burning scenarios. Using this information, the public can compare and evaluate potential emissions among the alternatives.
The SFMLRP EA and specialist report disclose the potential changes to stored carbon and how the implementation of the Proposed Action would move to stabilize carbon storage over time compared to no action (see EA Section 3.8.1 and 3.8.2).

Concerning Number 2. Due to approximately 100 years of fire suppression and past management practices, the proposed project area's ecosystems are now far outside the natural range of variability (or variation). Global warming or climate change effects are increasing the risk of severe drought and damaging wildfires. The information provided in the EA Section 3.8, Air Quality and Climate, and in the Fuels and Wildfire Behavior – Air Quality – Climate Change and Carbon Sequestration specialist report addresses the effects of climate change on the proposed project area and how the implementation of the Proposed Action would move the area towards meeting Santa Fe National Forest Land and Resource Management Plan's goals, objectives, and desired conditions. Moving towards or meeting desired conditions would increase ecosystem resilience and resistance to unnaturally intense, damaging wildfires and increase public safety in the WUI areas.

The EA addresses the effects of the proposed project on climate change under Section 3.8.2 (Air Quality and Climate). A response to comments regarding the effects of smoke is presented in Topic 2 (Air Quality, Wildfire, Wildland/Urban Interface), Theme 1 (Effects of Smoke) of this appendix.

Topic 9: Grazing

Theme 9-1: Grazing

Four comments (contained in letter numbers 79, 94, and 127) questioned whether the draft EA accurately and appropriately analyzes the impacts of the Proposed Action on livestock grazing and expressed concerns over the mitigation measures proposed to limit grazing impacts to soil and riparian areas. One comment suggested changing the language regarding fencing as a mitigation measure to reflect riparian restoration priorities and objectives outlined in the environmental assessment.

REPRESENTATIVE COMMENT(S):

- *The third paragraph on p. 38 reads: 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. If it is "needed to protect restored areas" and "it is determined that riparian vegetation regeneration is being hampered by browsing and grazing", then there is, by the wording of this very sentence, a "need". This should therefore be changed to: "Fencing will be installed if needed to protect restored areas if it is determined that riparian vegetation regeneration is being hampered by browsing and grazing." This wording also needs correction on p. 45: "For proposed riparian restoration activities within Tesuque Creek and Arroyo Hondo, fencing may be installed, if needed to protect restored areas if it is deemed that riparian vegetation regeneration is being hampered by browsing and grazing." For the same reason, this sentence should be changed to: "For proposed riparian restoration activities within Tesuque Creek and Arroyo Hondo, fencing will be installed, if needed to protect restored areas if it is deemed that riparian vegetation regeneration is being hampered by browsing and grazing."*

RESPONSE:

Through livestock management techniques of herding, season of use, and water and fencing infrastructure outside and along riparian areas, livestock can be limited to using riparian areas to meet desired conditions of riparian areas in accordance with the Santa Fe National Forest Plan. The project area is within an active grazing allotment that permits livestock grazing through various laws and regulations.

Fencing may not actually be a need. Fencing is a tool that can be used to manage browsing and grazing by animals but can also impede access to water for wildlife and livestock. Livestock can be managed by other management tools to promote riparian vegetation regeneration, such as duration of grazing in the area, timing, intensity or deferment of grazing from the area.

Topic 10: Inventoried Roadless Area

Theme 10-1: Inventoried Roadless Area

Sixteen comments (contained in letter numbers 24, 79, 84, 102, 113, 114, 123, 124, 125, 126, 127, and 130) expressed concerns about the need for treatment in the inventories roadless areas (IRAs), prevention of overland travel from becoming new roads in the IRAs, keeping illegal vehicles out of IRAs, protecting the wilderness properties of IRAs, and decommissioning roads. One comment questioned whether the Thompson Peak area should be treated as planned in the Proposed Action because the proposed treatment may affect the integrity of the wilderness.

REPRESENTATIVE COMMENT(S):

- *The proposed action of the Santa Fe National Forest Land Management Plan FEIS designates Thompson Peak as a recommended wilderness area. It is contained within the Thompson Peak IRA, an area that is proposed to receive fuel treatments in the SFMLRP. It has high level natural quality except for invasive weeds in some disturbed areas. Only a few closed roads are visible off of the eastern edge. There are three reaches with pure cutthroat trout (Regional Forester's sensitive species) present. (U.S. Forest Service 2018a, Vol. 3 at 162). This area must be maintained as free of disturbances as possible in order to maintain its wilderness quality.*

RESPONSE:

No new roads would be constructed in any of the IRAs. The SFMLRP area includes eight IRAs governed by the 2001 Roadless Conservation Rule. These IRAs comprise approximately 24,613 acres of the 49,786-acre SFMLRP area (EA Table 3.49), which is almost half of the entire project area. Excluding IRAs from the project area would defeat the purpose of the project. There are a total of 8.23 miles of existing classified roads within the IRAs found in the project area as discussed in EA Section 3.14, Inventoried Roadless Areas.

The Proposed Action described in EA Section 2.1.2 states that prescribed fire, riparian restoration, and manual and mechanical thinning treatments would occur within all eight of the IRAs within the project area. The restoration methods applied within the IRAs would use equipment and vehicles that do not require the use of new access roads (e.g., either vehicles would use existing roads within the IRA or vehicles capable of overland travel would be used). The project proposes up to 18,000 acres of mechanical or hand-thinning treatments, up to 38,000 acres of prescribed burning, up to approximately 680 acres of riparian restoration, and 1.5 miles of road closure. The road closure is to protect archaeological resources. Mechanical treatment would only occur on slopes with gradients less than 40 percent; manual treatments could occur on all slopes. Approximately 11,732 acres of the IRAs is on gradients less than 40 percent.

No permanent or temporary roads would be constructed, but existing roads, trails, and routes may be used for access. Where this occurs, the design features would require reclamation of these routes to pretreatment standards. See EA Appendix C for Rec-2 through Rec-5, which are mitigation measures intended to minimize impacts to recreation users. Overland travel by vehicles that do not require roads to be constructed (e.g., masticators, utility terrain vehicles) may occur.

Rec-2. If equipment must cross trails and roads, crossing would be minimal, perpendicular to the trail, and rehabilitated after treatment of the area.

Rec-3. Use of trails as access routes for heavy equipment should be considered carefully and other routes evaluated to best protect all resources, including recreation.

Rec-4. If trails must be used as access routes, they need to be fully reclaimed with sustainable trail practices implemented such as proper cut slope, width for managed use, and drainage features including rolling grade dips, water turnouts, armoring above and below the trail at drainage crossings, water bars, and check darns. Trail reconstruction will be coordinated with the U.S. Forest Service recreation team.

Rec-5. Avoid crossing or using motorized and nonmotorized system trails where feasible. If a trail or section of trail is affected, the trail shall be restored to the original condition. All treatment slash and debris would be removed from trails. It is acceptable to make perpendicular trail crossings. Trail crossing locations would be designated and flagged with input from a qualified U.S. Forest Service recreation staff or designated representative. Crossings of existing forest system trails would be restored to pre-project condition after use.

Rec-12. Disguise route entrances to firelines with rocks, boulders, downed trees, and forest litter to prevent them from being seen, easily accessed and becoming user trails. It should be difficult to access these areas for recreational use.

Soil-1. UTVs and ATVs may be used for transportation around the project area during implementation. To the extent possible, travel on existing routes and trails; if off-route travel must occur, avoid travelling across side-slopes; attempt to travel on ridges.

Soil-2. To protect road infrastructure from rutting, travel to and from the project area on Forest roads and trails would be limited during periods when resource damage could occur.

Soil-3. To the extent possible, existing disturbance areas (e.g., staging areas, access trails) would be utilized rather than creating new ones.

Soil-7. Prior to and during mechanical treatments, soil moisture conditions would be evaluated and monitored for operability. To prevent soil compaction and displacement, equipment (e.g., masticators, ATVs, UTVs, trucks) would only operate off of constructed roads when soil moisture is low, the ground is adequately frozen, or covered with sufficient snow.

The Santa Fe National Forest Travel Management Plan signed in 2013 (U.S. Forest Service 2013) prohibits motor vehicles to drive outside of designated roads and trails that are open to the particular class of motorized vehicles specified. As stated above, there are only 8.5 miles of existing motorized roads within the IRAs in the project area. Even so, unauthorized and illegal driving of motorized vehicles occurs throughout the forest. The concern that this will continue or get worse with the Proposed Action is valid. The Proposed Action will not prevent this trespass from continuing, although during implementation the increased presence of Forest Service personnel may help discourage unauthorized motor vehicle travel. Decommissioning of closed roads, along with plans and efforts to better enforce travel management, is beyond the scope of this EA. However, design features like Rec-12 (Appendix C) would lessen the possibility that overland travel routes would continue to be used as a new road within an IRA. The purpose of the Proposed Action is to lessen the chance of catastrophic fire which is the greatest threat to the landscape.

Efforts would be in place throughout implementation to protect the IRAs from new use of motorized vehicles as a result of the Proposed Action. Continued monitoring and enforcement of overland routes to prevent them from becoming new motorized roads will be in progress throughout implementation and beyond as part of the normal travel management implementation for the Santa Fe National Forest.

It is recognized that all of the IRAs, including Thompson Peak, are special areas to be protected for future generations, if not recommended wilderness areas in the future. Treatments where the proposed project and recommended wilderness overlap would need to comply with plan components for recommended wilderness areas. If this area were to become a wilderness area or the forest plan were to be amended, the conditions-based approach would allow flexibility to conform to the forest plan.

The Proposed Action will not preclude future decisions as described in the EA Section 3.14.2, under the Inventoried Roadless Area discussion. Impacts to the nine characteristics of IRAs, as described in detail in the EA, vary depending upon the affected resource. While some short-term adverse impacts may occur, they are generally outweighed by the long-term benefits of the Proposed Action, including the reduced risk for high-severity wildfire. The adverse impacts would occur on less than 16% of the total IRA acreage within the project area and would generally be mitigated by the design features developed for the project. This project is also expected to reduce risks of high-severity, stand-replacing wildfires; thereby resulting in long-term beneficial impacts across all 24,613 acres of IRA within the SFMLRP area (U.S. Forest Service 2021a).

There would be moderate, temporary traffic on County Road B52 to access Forest Road 50A where there are some small units identified for possible treatment. Crews would be transported primarily with pickup trucks and will stay on the public right-of-way roads only. There is no work proposed in Pecos Canyon, so there would be no vehicle traffic in this area from the proposed project. The La Cueva Road is generally the southeastern/eastern boundary of the project. More thinning would take place primarily along the road north of the recent treated areas (farther from the village of La Cueva); vehicle travel to conduct those treatments would involve primarily pickup truck traffic and the amount would vary according to the amount of work that may be needed.

Topic 11: Visual Resources

Theme 11-1: Visual Resources

Four comments (contained in letter numbers 98, 114, 119, and 130) questioned the assumptions outlined in the EA regarding the long-term positive effects of the proposed project on the scenic character of the project area and of the public perception of these changes. One comment expressed concerns about the impacts of the Proposed Action on Santa Fe–area residents.

REPRESENTATIVE COMMENT(S):

- *Many areas of the project area are easily accessible to the public for recreational uses. The Forest Service assumes that fuel treatments around recreation infrastructure would be seen by most people as a change that improves aesthetics: "Maintaining vegetation clearances or establishing new forest health practices around recreation infrastructure may result in changes to the recreation setting that people have grown accustomed to, but these changes would be intended to benefit the recreation setting in the long term. It would likely be perceived as an improved aesthetic change by most (U.S. Forest Service 2021b)." EA at 160. This is an unproven and unlikely assumption, and in fact many Santa Fe area residents express that they do not like the look of very open and dry forest, stumps and charred trees. […]*

RESPONSE:

The Proposed Action is expected to move the project area vegetation toward the desired scenic character. There will be short-term effects from project activities but in the long term, the effects are expected to make the vegetation conditions more heterogenous and resilient to uncharacteristic disturbances (see EA Section 3.10, Scenery). Design Features Rec-1, Rec-9 through Rec-13, and Scen-1 through Scen-10 will help reduce contrasts that detract from the natural appearance of the project area scenery (see Appendix C).

Visual preferences for forest settings vary widely with the general public. See EA Section 3.10.2, under Scenery, for generalizations that were noted for public preferences. It was noted in a 2008 study by Hill and Daniel that the public often judges the ecological health of a forest by appearance. Preferences for landscapes with large tees, openings, and varied spatial distribution for vegetation that provides views through the site and into the landscape were noted (Brown and Daniel 1984, 1986, 1987; Ryan 2005).

It is recognized that beyond these generalizations, individual preference varies widely and not everyone would see the restoration activities as a positive change long term. However, the risk of catastrophic fire with the No Action Alternative may mitigate some of the concerns over the potential alterations of forest aesthetics. Most would agree that the radical change in a stand-replacing fire would not be a desirable change.

To protect archaeological resources, a 1.5-mile road segment would be permanently closed. This short section of rough road does not add to the quality of the recreation experience for most. There are numerous alternatives for those who are looking for recreational driving experiences. There is a visual buffer around campgrounds where there is no treatment. See Design Feature Rec-1 in EA Appendix C.

Rec-1. Create a 150-foot visual buffer around campgrounds and picnic areas where no thinning or piling would occur. Prescribed fire would be allowed to back into these areas. Also see Design Features Rec-9 through Rec-13 that further protect the visual quality of recreation areas and trails.

Rec-9. Stumps will be cut to a maximum of 8 inches within 50 feet of National Forest System trails, and as low as possible in all other distances zones.

Rec-10. Paint and markings, such as butt marks, leave-tree, and boundary markings within 150 feet of National Forest System trails, roads, and campgrounds would be applied facing away from these areas to reduce visibility. Flagging would be used in these areas, where practical, to mark unit boundaries and should be removed upon project completion.

Rec-11. Cut trees flush with trail when they need to be cut on the edge of the trail and road.

Rec-12. Disguise route entrances to firelines with rocks, boulders, downed trees, and forest litter to prevent them from being seen, easily accessed, and becoming user trails. It should be difficult to access these areas for recreational use.

Rec-13. Activity-generated fuels created within 150 feet of National Forest System trails and roads would be piled and burned or removed within 2 years of operations and within 1 year for areas managed for a Visual Quality Objective of Retention. Where possible, leave a vegetative buffer of at least 33 feet alongside the trail.

None of the Proposed Action activities would occur in this buffer. Routine maintenance will occur such as maintaining clearance around recreation infrastructure and mitigating hazard trees.

Appendix H

Table A-1. Comment Coding Structure

Ecosystem Management Coordination
CARA | Comment Analysis and Response Application

Coding Structure Report

Project: Santa Fe Mountains Landscape Resiliency Project (55088)

Comment Period: Notice of Availability -

Period Dates: 9/29/2021 - 10/29/2021 **Generated:** 1/28/2022 3:32 PM

Code #	Code Name	Comment Count
Total Comments		777
Issue/Action		
101	Code TBD/Pending	0
102	No Further Response Required	248
102.01	Beyond Scope	13
102.02	Position, No Rationale	227
102.03	Already Addressed	5
110	Decision Process	1
110.02	Coordination, Consultation	0
110.04	Laws, Policies	0
110.05	General Use of Science	11
110.06	Land Mgmt Emphasis	0
111	Public Involvement	23
111.01	Outreach/Education	1
111.02	Collaboration, Meetings	0
111.03	Comment Period	0
112	Agency Organization	0
112.01	Funding, General	0
112.02	Staffing	0
112.03	Outsourcing, Contracting	0

Coding Structure Report

Code #	Code Name	Comment Count
Issue/Action		
120	Proposed Action, Decision	3
120.01	Purpose and Need	0
120.02	Analysis type (CE, EA, EIS)	0
121	Issues, Alternatives	0
121.01	Alts. Not Analyzed In Detail	0
121.0201	Preferred Alternative	0
121.0202	No Action Alternative	0
122	Effects Analysis	1
122.01	Cumulative Effects Analysis	0
123	Technical, Editorial	0
130	Resource & Area Mgmt	0
130.01	Monitoring	0
130.02	Inventories, Mapping, GIS	0
132	Water, Watershed Mgmt	3
132.01	Riparian Area Mgmt	0
132.02	Water Infrastructure Mgmt	0
133	Air and Climate	9
133.01	Air Quality Mgmt	0
133.02	Climate Change	0
134	Soils Mgmt	0
134.01	Slope or Erosion Control	0
135	Minerals & Geology Mgmt	0
135.01	Minerals & Rock	0
135.02	Oil & Gas	0
135.03	Plan of Operation, Processes	0
135.04	Reclamation, Cleanup, Bonding	0
135.05	Mineral Uses, Alternatives	0

Coding Structure Report 2 of 6 1/28/2022 3:32:29 PM

Code #	Code Name	Comment Count
Issue/Action		
136	Fire and Fuels Mgmt	138
136.01	Suppression	0
136.02	Fuel Treatment, Reduction	10
136.03	Prescribed Burns	8
136.05	Safety, Risk Mgmt.	0
136.06	Wildland/Urban Interface	0
136.07	Smoke Mgmt	1
140	Biological Resources Mgmt	2
141	Vegetation Mgmt	11
141.01	Introduction, Planting, Seeding	0
141.02	Insects and Disease Treatment	0
141.03	Invasive Vegetation Treatment	0
142	Timber Mgmt	8
142.04	Harvest Methods	1
142.06	Allowable Sale Quantity (ASQ)	0
142.08	Other Uses	0
143	Wildlife/Animals Mgmt	26
144	Domestic Livestock, Grazing Mgmt	4
149	Other Activities Mgmt	0
149.01	Utility Corridors, Facilities	0
149.05	Permits (excl. rec. & grazing)	0
149.06	Valid Existing Rights	0
150	Trans. Sys. Mgmt (& non-rec. access)	0
150.02	Non-System, User-Created	0
150.03	Transportation Analysis	0
151	Roads Management	16
151.01	Road Construction, Maint.	0

Coding Structure Report

Code #	Code Name	Comment Count
Issue/Action		
152	Trails Management	1
160	Recreation Mgmt	3
162	Recreational Access	0
163	Developed Rec. and Facilities	0
164	Motorized Recreation Mgmt	0
164.0101	Full size vehicle use	0
164.0102	Single-track motorcycle use	0
164.0103	4- and 3-wheeler use	0
165	Dispersed Recreation Mgmt	0
165.03	Hunting, Shooting	0
165.04	Fishing	0
165.05	Equestrian/Pack Animals	0
165.06	Bicycling	0
170	Land Ownership, Uses	0
171	Land Designations/Mgmt	2
171.02	Designated Wilderness Areas	0
171.07	Wild and Scenic Rivers	0
180	Econ. & Soc. Actions, Analyses	0
182.01	Cultural, Hist., Anthro. Mgmt	1
Total Comments for Issue/Action		**777**
Resource/Rationale		
202	No Further Response Required	0
202.01	Beyond Scope	0
202.02	Position, No Rationale	0
202.03	Already Addressed	0
203	Multiple Resources/Reasons	0

Coding Structure Report 4 of 6 1/28/2022 3:32:29 PM

Code #	Code Name	Comment Count
Resource/Rationale		
210	Persons, Groups	0
215	Forest Plan	0
220	Laws, Policies, Courts	0
220.0301	NEPA	0
220.0303	Endangered Species Act	0
230	Natural Environment	0
230.03	Forest Health	0
232	Water Resources	0
233	Air and Climate	0
233.01	Air Quality	0
233.02	Climate Change	0
234	Soils	0
235	Minerals & Geol. Resources	0
235.01	Minerals & Rock	0
235.02	Oil & Gas	0
236	Fire, Fire Risk	0
236.01	Wildland/Urban Interface Cond.	0
240.01	Ecosystem, Habitat Health	0
240.0101	Disturbance Regimes	0
240.02	Diversity, Extinctions	0
240.03	Species: TES, etc.	0
241	Vegetation	0
241.01	Plant Species: TES, etc.	0
241.02	Invasive, Noxious Plant Species	0
243	Wildlife/Animals	0
250	Transportation System	0
260	Recreation	0

Coding Structure Report

Code #	Code Name	Comment Count
Resource/Rationale		
260.01	User Conflicts	0
270	Lands, Condition, Designation	0
270.01	Potential for Special Designation	0
270.02	Wilderness, Roadless Character	0
270.03	Adjacent Lands	0
280	Econ. & Social Conditions	0
282	Social Conditions and Values	0
282.01	Quality of Life	0
282.0103	Traditional Way of Life	0
282.0105	Scenery, Visual Resources	0
282.0106	Noise	0
282.02	Health, Safety	0
Total Comments for Resource/Rationale		**0**
Early Attention		
501	Threat of harm	0
502	Notice of appeal or litigation	0
503	Proposed new alternative	0
504	Requires detailed review	0
505	Government entities	0
506	Request public meeting, etc .	0
507	Requests for Information	0
507.01	FOIA	0
507.02	Request Documents or Info	0
508	Comment Period Extension	0
Total Comments for Early Attention		**0**

Coding Structure Report 6 of 6 1/28/2022 3:32:29 PM

Appendix I

Table B-1. Draft Environmental Assessment Comments Received

Name	Organization or Individual	Date Letter Was Submitted
Claire Frye	Individual	10/29/2021
Roger Frye	Individual	10/29/2021
Paula Seaton	Seaton Guardianship Service	10/29/2021
Ann McCampbell	Multiple Chemical Sensitivities Task Force of New Mexico	10/29/2021
Jan Boyer	OnceAForest.org	10/29/2021
Peggy McCarty	Individual	10/29/2021
Gary Sharlow	Individual	10/29/2021
Ann McCampbell	Multiple Chemical Sensitivities Task Force of New Mexico	10/29/2021
Emmy Koponen	Individual	10/29/2021
Lauren McGavran	Individual	10/29/2021
David Buettner	Individual	10/29/2021
Ann McCampbell	Multiple Chemical Sensitivities Task Force of New Mexico	10/29/2021
Jaime Lehner	Individual	10/29/2021
Juliana Sloane	Individual	10/29/2021
Ann Campbell	Multiple Chemical Sensitivities Task Force of New Mexico	10/29/2021
Sylvia Williamson	Individual	10/29/2021
Dyan Oldenburg	Individual	10/29/2021
Jon Asher	Individual	10/29/2021
Lillian Koponen	Individual	10/29/2021
Sarah Hyden	Individual	10/29/2021
Logan Glasenapp	Individual	10/29/2021
Simone Griffin	Individual	10/29/2021
Craig Jolly	Individual	10/28/2021
Mollie West	Individual	10/28/2021
Gregory Walke	Individual	10/28/2021
Grietje Laga	Individual	10/28/2021
Kenneth Klerlein	Individual	10/28/2021
David Birnbaum	Individual	10/28/2021
May Smith	Individual	10/28/2021
Daniela Roth	EMNRD – Forestry Division	10/28/2021
Nancy Windheart	Individual	10/27/2021
Marsha Emmerton	Individual	10/27/2021
Patricia Mann	Individual	10/27/2021
Evelyn Kunkel	Individual	10/27/2021
Don & Alberta Montgomery	Individual	10/27/2021

Name	Organization or Individual	Date Letter Was Submitted
Sunsan Abod	Individual	10/27/2021
Susan Schmall	Individual	10/27/2021
Carol Johnson	Individual	10/27/2021
Kurt Stritzl	Individual	10/26/2021
Adam Wasserman	Individual	10/26/2021
Sandy Zinn	Individual	10/26/2021
Melanie West	Individual	10/26/2021
Sophia Garrett	Individual	10/26/2021
Lucy Smith	Individual	10/26/2021
Bill Dam	Individual	10/26/2021
April Lowe	Individual	10/26/2021
Billie Bolton	Individual	10/26/2021
T. Tiegler	Individual	10/25/2021
Annon	Individual	10/25/2021
Garrick Beck	Individual	10/25/2021
Maria Spray	Individual	10/25/2021
Nina Simons	Individual	10/24/2021
Marta Ballen	Individual	10/24/2021
Makarand Karmarkar	Individual	10/24/2021
Kristen Speakman	Individual	10/24/2021
Gene Nathan	Individual	10/24/2021
Oksana Yufa	Individual	10/24/2021
Cathryn Schmidt	Individual	10/24/2021
Janet Tomski Anon	Individual	10/24/2021
Selah Kaiser	Individual	10/24/2021
Nancy Brannin	Individual	10/24/2021
Jane Lottimer	Individual	10/23/2021
Ann Harvey	Individual	10/23/2021
Gregg Manoff	Individual	10/23/2021
Dawn Ehrhard-Wingard	Individual	10/23/2021
Brenna James	Individual	10/23/2021
Tod Davis	Individual	10/23/2021
Cynthia Wilcox	Individual	10/23/2021
Patricia Walke	Individual	10/23/2021
Julie Rose	Individual	10/23/2021
Ann E Briggs	Individual	10/23/2021
Nomi Gallo	Individual	10/23/2021
Audrey Walker	Individual	10/23/2021
Jonathan Crews	Individual	10/23/2021

Name	Organization or Individual	Date Letter Was Submitted
Cinny Green	Individual	10/23/2021
Lois Purvis	Individual	10/22/2021
Monica Dick	Individual	10/22/2021
Sharon Smith	Individual	10/22/2021
James Smith	Individual	10/22/2021
John Ritter	Individual	10/21/2021
Robert Reilly	Individual	10/21/2021
Kathleen	Individual	10/21/2021
Barb Satink Wolfson	Individual	10/20/2021
Mark Wingard	Individual	10/19/2021
Kunkowski Bedajii	Individual	10/19/2021
Carla Newbre	Individual	10/19/2021
Susan Paquet	Individual	10/19/2021
Dorothy Roberts	Individual	10/19/2021
Michael Holland-Moritz	Individual	10/19/2021
Anon	Individual	10/19/2021
Seth Knight	Individual	10/19/2021
Maya Aubrey	Individual	10/18/2021
Carol Teutsch	Individual	10/18/2021
Michael Cherin	Individual	10/18/2021
Charlotte Levinson	Individual	10/18/2021
Janine Pearson	Individual	10/18/2021
Tim Blose	Individual	10/18/2021
Nancy Murphy	Individual	10/16/2021
Francois-Marie Patorni	Individual	10/15/2021
Willa Tanas	Individual	10/15/2021
Janet Duncan	Individual	10/14/2021
Gordon Smith	Individual	10/14/2021
Rachel Miller	Individual	10/14/2021
Stephen Schmidt	Individual	10/14/2021
Jon Klingel	Individual	10/14/2021
Kenneth Barnett	Individual	10/13/2021
Lucie Brennan	Individual	10/12/2021
Gary Magnus	Individual	10/12/2021
William Schneider	Individual	10/11/2021
Amy Maki	Individual	10/11/2021
Pete Meyers	Individual	10/11/2021
Rebecca Alvarez	Individual	10/10/2021
Harvey Wasserman	Individual	10/09/2021

Name	Organization or Individual	Date Letter Was Submitted
Ariëlle Verweij	Individual	10/09/2021
Anna Gieselman	Individual	10/07/2021
Alasdair Lindsay	Individual	10/06/2021
JC Corcoran	Individual	10/06/2021
Doug Booth	Individual	10/05/2021
Janet Harry	Individual	10/05/2021
Scott Ernst	Individual	10/01/2021
Esme Cadiente	Forest Stewards Guild	09/30/2021

Literature Cited

Baker, W.L. 2017. Restoring and managing low-severity fire in dry-forest landscapes of the western USA. *PLoS ONE* 12(2).

Brown, T.C., and T.C. Daniel. 1984. *Modeling Forest Scenic Beauty: Concepts and Application to Ponderosa Pine*. Research Paper RM-RP-256. Fort Collins, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

———. 1986. Predicting scenic beauty of timber stands. *Forest Science* 32(2):471-487.

———. 1987. Context effects in perceived environmental quality assessment: Science selection and landscape quality ratings. *Journal of Environmental Psychology* 7:233-250.

Clewell, A., J. Rieger, and J. Munro. 2005. *Guidelines for Developing and Managing Ecological Restoration Projects*, 2nd ed. Tucson, Arizona: Society for Ecological Restoration International. Available at: www.ser.org/content/guidelines_ecological_restoration.asp.

Coop, J.D., Schoettle, A.W., 2009. Regeneration of Rocky Mountain bristlecone pine (Pinus aristata) and limber pine (Pinus flexilis) three decades after stand-replacing fires. For. Ecol. Manage. 257, 893–903.

Conklin, D., Fairweather, M., Ryerson, D., Geils, B., Vogler, D., 2009. White Pines, Blister Rust, and Management in the Southwest. USDA Forest Service Forestry and Forest Health R3-FH-09-01, 17p.

Danzer, S.R., Baisan, C.H., Swetnam, T.W., 1996. The influence of fire and land-use history on stand dynamics in the Huachuca Mountains of southeastern Arizona. In: Pfolliott, P.F., DeBano, L.F., Baker, M.B., Gottfried, G.J., Solis-Garza, G., Edminster, C.B., Neary, D.G., Allen, S., Hamre, R.H. (Eds.), Effects of Fire on Madrean Province Ecosystems: A Symposium. USDA Forest Service Rocky Mountain Research Station, Gen. Tech. Rep. RM-GTR 289, pp. 265–270.

Dieterich, J.H., 1983. Fire history of southwestern mixed-conifer: a case study. For.Ecol. Manage. 6, 13–31.

Goodrich, A., Waring, K., and Kolb, T. 2016 Genetic Variation in Pinus Strobiformis growth and drought tolerance from southwestern US populations. Tree Physiol. 36(10):1219-1235.

Gottfried, G.J., 1992. Growth and development in an old-growth Arizona mixed-conifer stand following initial harvesting. For. Ecol. Manage. 54, 1–26.

Hill, D., and T. Daniel. 2008. Foundations for an ecological aesthetic: Can information alter landscape preferences? *Society and Natural Resources* 21:34-49.

Hurteau, M.D. 2017. Quantifying the carbon balance of forest restoration and wildfire under projected climate in the fire-prone southwestern US. *PLoS ONE* 12(1):e0169275. Available at: https://doi.org/10.1371/journal.pone.0169275.

Iniguez, J.M., Swetnam, T.W., Yool, S.R., 2008. Topography affected landscape fire history patterns in southern Arizona, USA. For. Ecol. Manage. 256, 295–303.

Kaufmann, M., Huckaby, L., Regan, C., Popp, J., 1998. Forest Reference Conditions for Ecosystem Management in the Sacramento Mountains, New Mexico. USDA Forest Service Rocky Mountain Research Station, Gen. Tech. Rep. RMRS-GTR-19, 87p.

Kegley, S. 2011. *Douglas-fir Beetle Management*. USDA Forest Service, Forest Health Protection and State Forestry Organization. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187396.pdf.

Livingston, L. 2010. *Management Guide for Pine Engraver*. USDA Forest Service, Forest Health Protection and State Forestry Organization. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187526.pdf.

Looney, C.E. and Waring, K.M. 2013. Pinus strobiformis (southwestern white pine) stand dynamics, regeneration, and disturbance ecology: A review. For. Ecol. Manage. 287, 90-102.

Margolis, E.Q., Balmat, J., 2009. Fire history and fire-climate relationships along a fire regime gradient in the Santa Fe Municipal Watershed, NM, USA. For. Ecol. Manage. 258, 2416–2430.Pederson, L., N. Sturdevant, and D. Blackford. 2011. Western Spruce Budworm Management. Chapter 6.1 in *Forest Insect and Disease Management Guide for the Northern and Central Rocky Mountains*. USDA Forest Service, Northern Region, State and Private Forestry. Available at: https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5186684.pdf.

Pilliod, D.S., E.L. Bull, J.L. Hayes, and B.C. Wales. 2006. *Wildlife and Invertebrate Response to Fuel Reduction Treatments in Dry Coniferous Forests of the Western United States: A Synthesis*. General Technical Report RMRS-GTR-173. Fort Collins, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Randall, C.B. 2010a. *Management Guide for Western Pine Beetle*. USDA Forest Service, Forest Health Protection and State Forestry Organization. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5188577.pdf.

———. 2010b. *Management Guide for Douglas-fir Tussock Moth*. USDA Forest Service, Forest Health Protection and State Forestry Organization. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187412.pdf.

———. 2012. *Management Guide for Fir Engraver*. USDA Forest Service, Forest Health Projection and State Forestry Organization. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187436.pdf.

Ryan, R.L. 2005. *Social Science to Improve Fuels Management: A Synthesis of Research on Aesthetics and Fuels Management*. General Technical Report NC-261. St. Paul, Minnesota: U.S. Department of Agriculture, Forest Service, North Central Research Station.

Sakulich, J., Taylor, A.H., 2007. Fire regimes and forest structure in a sky island mixed-conifer forest, Guadalupe Mountains National Park, Texas, USA. For. Ecol. Manage. 241, 62–73.

U.S. Fish and Wildlife Service (USFWS). 2012. *Final Recovery Plan for the Mexican Spotted Owl (*Strix occidentalis lucida*), First Revision.* Albuquerque, New Mexico: U.S. Fish and Wildlife Service, Region 2. Final approval date November 2012.

U.S. Forest Service. 1993. *Terrestrial Ecosystem Survey of the Santa Fe National Forest*. Technical report on file. Southwestern Region, Albuquerque, New Mexico.

———. 2009. *Climate Change Considerations in Project Level NEPA Analysis*. Available at: https://www.fs.fed.us/emc/nepa/climate_change/includes/cc_nepa_guidance.pdf. Accessed January 2022.

———. 2013. *Santa Fe National Forest Travel Management Implementation Plan*. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5431127.pdf. Accessed January 2022.

———. 2016. *Tongass National Forest Land and Resources Management Plan Amendment EIS/ROD.* Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd527907.pdf. Accessed October 2021.

———. 2018b. *Santa Fe National Forest Invasive Plant Control Project Record of Decision*. Available at: https://www.fs.usda.gov/nfs/11558/www/nepa/54698_FSPLT3_4357827.pdf. Accessed March 3, 2020.

———. 2021a. *Santa Fe Mountains Landscape Resiliency Project: Inventoried Roadless Areas Effects Analysis*. Prepared for U.S. Department of Agriculture, Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. February 12. Revised 2022.

———. 2021b. *Santa Fe Mountains Landscape Resiliency Project: Recreation Effects Analysis*. Prepared for U.S. Department of Agriculture, Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. June 29.Revised 2022.

———. 2021c. *Biological Assessment for the Santa Fe Mountains Landscape Resiliency Project*. Prepared for U.S. Department of Agriculture, Forest Service, Española and Pecos-Las Vegas Ranger Districts, Santa Fe National Forest. July 14.

———. 2022. *Santa Fe National Forest Land Management Plan Rio Arriba, San Miguel, Sandoval, Santa Fe, Mora, and Los Alamos Counties, New Mexico*. MB-R3-10-28. July 2022 U.S. Department of Agriculture, Forest Service, Southwestern Region.

This page intentionally left blank.