Section 12- Landscape Strategy

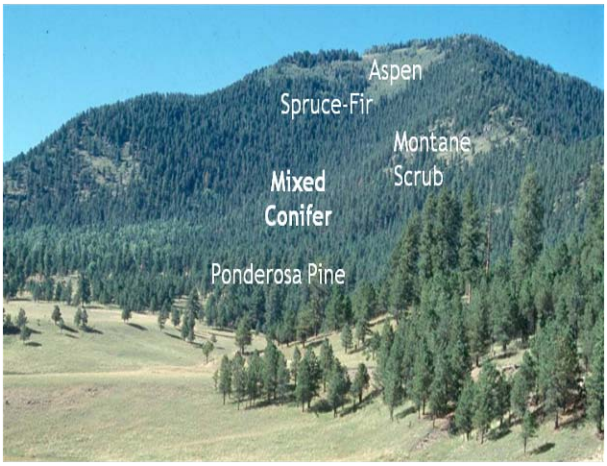
Southwest Jemez Mountains Collaborative Forest Landscape Restoration Strategy

Proposal for Funding

Contents

Area Overview

The Southwest Jemez Mountains (SWJM) landscape area covers 210,000 acres in the Jemez Mountains in the central region of New Mexico, as shown on the cover page vicinity map (see Maps). It comprises most of the Jemez River watershed-- Upper and Middle Jemez River 5th-level Hydrologic Unit Code areas and additional portions of the 4th-level HUC. Elevations range from 11,200 feet down to 5,500 feet, from the high elevation headwaters of the watershed and the spruce-fir forests, through the drier mixed conifer and ponderosa pine forests, down to the low elevation piñon-juniper woodlands and grasslands.



This heavily forested area lies at the center of the most populated and fastest growing counties in the State- Bernalillo, Sandoval, and Santa Fe, along with Rio Arriba and Los Alamos counties (over 960,000 total residents). It is close to Interstates 25 and 40. Highway 4, a national scenic byway, provides easy access to and through the area from the surrounding cities of Albuquerque, Rio Rancho, Bernalillo, Santa Fe, Los Alamos, and Española.

This area has many remarkable values that are threatened by current conditions and trends and in need of protection. Scenic vistas, wild and scenic rivers, unique natural areas and wildlife are a magnet for nature enthusiasts and part of why the area is New Mexico's premier tourist destination for outdoor recreation. The highest density of archaeological sites in the U.S. is in this area, including ancient Anasazi Indian ruins, along with significant prehistoric fossil sites.

The area includes the Pueblo of Jemez, a sovereign Tribal Nation and spiritual community. Most of their 3,500 tribal members reside in the puebloan village where they maintain their traditional Towa language, culture and religious practices. The Jemez Pueblo, along with six other tribes in the area, use the SWJM area for traditional cultural practices; thus the Jemez Mountains are culturally and spiritually very significant to these seven tribes.

The area contains some of the most biologically diverse ecosystems and wildlife habitats in the Southwest, including several threatened and endangered species. Additionally, water flowing from this mountainous landscape feeds the municipal water supply for the greater Albuquerque-Rio Rancho area as well as many small communities.

Land jurisdictions are unique in this SWJM area, as it is predominantly National Forest System (NFS) land, managed by two distinct authorities: the US Forest Service-Santa Fe National Forest (Forest) and Valles Caldera Trust-Valles Caldera National Preserve (Preserve). The Preserve is an experiment in managing NFS land through a board of trustees comprised of a mix of government and non-government officials (www.vallescaldera.gov/). Private communities and properties are scattered throughout the area, including the Village of Jemez Springs, as well as a portion of Jemez Pueblo tribal land. Other Pueblo and National Park Service Land border the area. Table 12.1 and the map in Figure 12.1 display the distribution of land jurisdictions in the area.

Table 12.1. Land Jurisdictions in the SWJM Landscape Area

Land Jurisdiction	Acres	Percent
Forest Service	110,427	52%
Valles Caldera Trust	86,200	41%
Private	9,820	4%
Pueblo of Jemez	3,845	2%

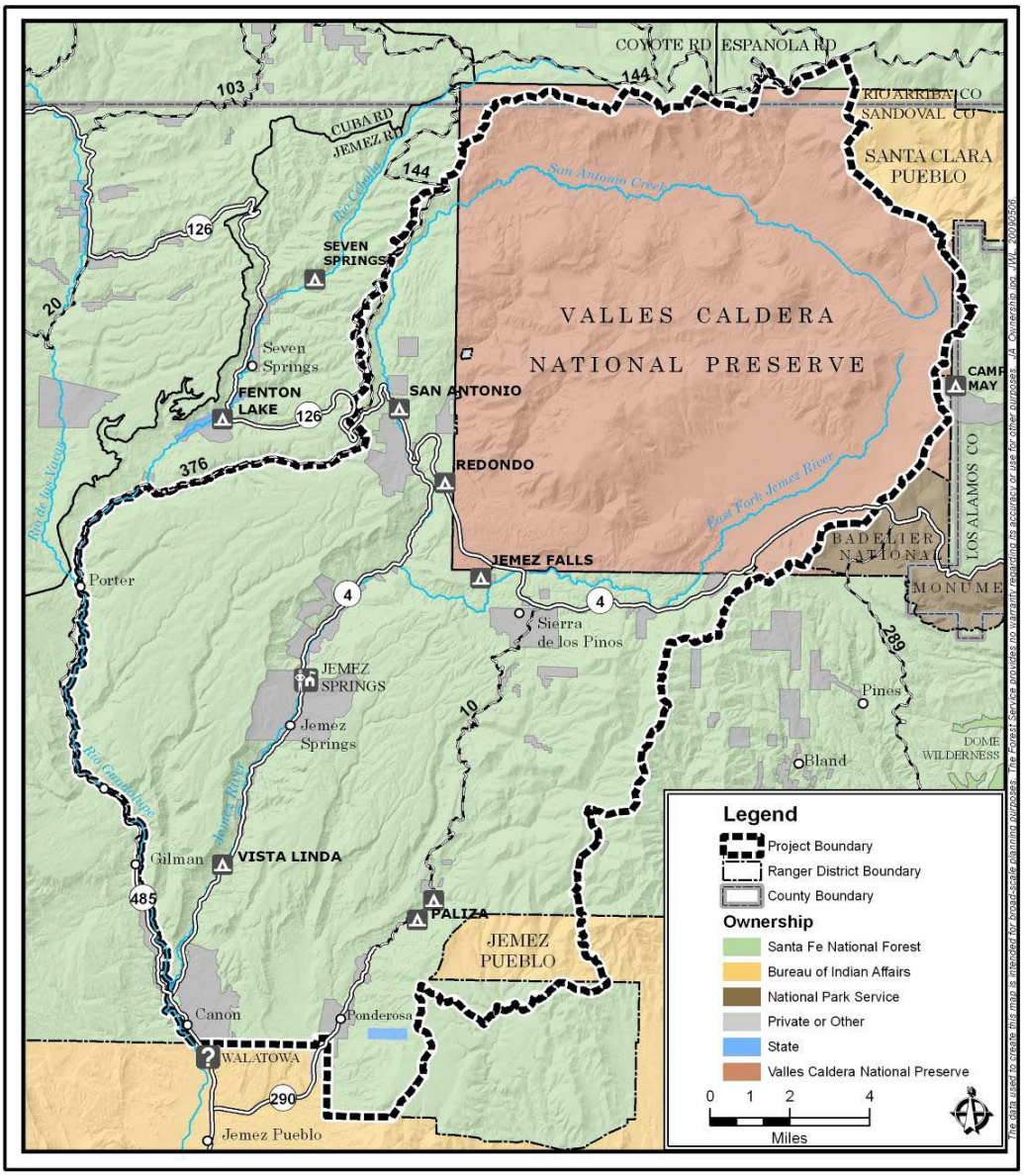


Figure 12.1. SWJM Landscape Area and Land Jurisdictions

In addition to treatments on NFS and Jemez pueblo land, the SWJM restoration strategy includes 6,530 acres of treatments on adjoining Santa Clara Pueblo (Pueblo) and Bandelier National Monument (Bandelier) land. Inclusion of these treatments in this 10-year restoration strategy is very important, primarily due to the continuity of ponderosa pine and mixed conifer forests in highly altered fire-regime condition classes crossing the NFS boundary, combined with the topography and prevailing wind direction. A fire starting on NFS land could easily spread as a destructive crown fire into the Pueblo, Bandelier, Los Alamos, and Los Alamos National Laboratory (a $6 billion dollar complex of nuclear research facilities). Also, proposed thinning and burning treatments on Pueblo and Bandelier land overlap NFS land due to logical fuelbreak locations and other factors, and a proposed riparian and beaver habitat restoration treatment has been collaboratively designed across Pueblo and Preserve lands in the area. Private lands intermixed with NFS lands may also receive restoration treatments to elevate the potential for success with this strategy, through partnerships among the willing landowners, the Forest Service, State Forestry, National Resource Conservation Service (NRCS), and the Soil and Water Conservation District (SWCD).

This area of central New Mexico is the most economically and culturally diverse in the state, from its paleo-Indian people who lived here thousands of years ago to Intel's semiconductor fabrication plants. Many rural residents maintain a traditional-cultural subsistence lifestyle that includes use of the area's wood for heating, cooking, fences, and construction materials; fish and wild game animals for food; grasses for livestock grazing; piñon-nuts and other edible fruits and plants for consumption or sale; and other natural resource uses. Many locals are employed as outfitter-guides or in other recreation or tourism-based jobs, while many other residents are employed in high-technology jobs in nearby cities. Populations of Sandoval, Bernalillo and Santa Fe Counties have grown much faster than state and national averages and offer the highest wages in the State (www.mrcog-nm.gov).

Another unique aspect to this area is the long-term land management partnership between scientific researchers and managers on the Forest and Preserve, which has helped ensure the use of the best available science to inform management decisions. This research-management partnership expanded significantly over this past decade to include numerous other organizations, agencies and tribes interested in restoring ecological conditions in the area. Professionals from over 50 different groups have been working collaboratively on ecosystem conditions assessments, research studies, monitoring systems, environmental education programs, wildlife conservation plans, community wildfire protection plans, stream restoration and heritage preservation programs, and other focal areas in this landscape. The common denominator has been the desire to restore and maintain healthy forest and watershed conditions in this area for current and future generations. See details in the following section on Collaboration.

Collaboration

Partners Committed to Long-Term Collaboration

The SWJM strategy was developed by a very diverse mix of organizations with a broad range of perspectives and values, including many who have been collaborating on forest and watershed management in the SWJM area for over a decade. These organizations became not only cooperators but active forest restoration partners, including those with a previous adversarial relationship with the Forest Service. Their capacity to partner with the Forest and Preserve has

greatly expanded over the past 10 years as they worked together on landscape and watershed assessments, research studies, land management policies and restoration projects in the area. Over 40 different agencies, tribes, and organizations worked closely together to develop this restoration strategy and proposal (listed in the Proposal). The recent efforts to complete this SWJM strategy and proposal formed an exhilarating peak in a long collaborative journey. It showed how various assessments, research, and projects from different organizations could be pulled together into an integrated strategy to accelerate restoration of this large landscape.

Past Collaboration Framework.

In May 2000, cross-jurisdictional partnerships in the Jemez Mountains were mobilized and intensified by the Cerro Grande Fire that swept through 45,000 acres of forest and the city of Los Alamos, directly adjacent to the SWJM area. Managers and staff from the Forest, Bandelier National Monument, Jemez and Santa Clara Pueblos, Los Alamos National Lab (LANL), Los Alamos County, and others teamed up to rehabilitate the fire-ravaged lands and reduce the future risk of large high-intensity wildfires in the Jemez Mountains. Also in 2000, The Nature Conservancy (TNC) developed the Southern Rocky Mountains Eco-Regional Assessment, which identified the Jemez Mountains as a critical conservation area for preserving the region's biological diversity. This importance, along with the severe threat of altered fire regimes, led to formation of the Jemez Mountains Fire Learning Network, one of the first Fire Learning Network collaborative that TNC and federal partners formed in the U.S.

After that, diverse groups of government agencies, tribes, conservation organizations, and local stakeholders expanded their collaborative efforts aimed at assessing and restoring ecological conditions and trends in the Jemez Mountains. In 2010, the SWJM collaborative group reviewed the restoration goals and objectives developed by these various collaborative workgroups in the past and integrated them into goals and objectives for the SWJM restoration strategy.

Past collaborative efforts that facilitated development of the SWJM strategy included:

- 2002: The Firewise Jemez Wildland Urban Interface Assessment, which focused on wildfire hazards on private lands scattered throughout the SWJM area (GEJWUIWG 2002); and the Jemez National Recreation Area Management Plan and East Fork Jemez Wild and Scenic River Management Plan, which included detailed assessments of conditions and identification of restoration needs
- 2003: The Jemez Mountains Fire Learning Network, a highly diverse collaborative group that completed an assessment of ecosystem conditions and restoration needs in the area (TNC 2003)
- 2004: The Jemez River Watershed Restoration Action Strategy, which described watershed and water quality conditions in this area (NMED 2005), tiering off the Statewide Unified Watershed Assessment that ranked the Jemez Watershed as a Category I watershed in most urgent need of restoration
- 2005: The Upper and Middle Jemez River Watershed Landscape Assessment, which evaluated conditions, trends, and threats on NFS lands in the Jemez River Watershed
- 2001-2007: Seven Community Forest Restoration Program (CFRP) projects in the SWJM area, based on the New Mexico Community Forest Restoration Act, which involved collaboration among agencies, tribes, conservation groups, research scientists, landowners and business partners to plan, implement and monitor; included three

stewardship contracts; acted as demonstration sites for a variety of restoration and contract methods proposed in the strategy; helped train minority and youth groups; stimulate local rural economies; provided research on old growth ponderosa pine, hazardous fuel reduction, goshawk habitat restoration, changes in water yield, small wood utilization, beaver habitat restoration, wetland firebreaks, and job creation for minorities and youth. These CFRP projects and key collaborators are listed below by project initiation date.

  - Monument Canyon Research Natural Area project to examine use of thinning and burning to maintain old growth ponderosa pine, involving Rocky Mountain Research Station, University of Arizona, Jemez Pueblo, federal and state agencies, and other groups (2001)
  - Hazardous fuels reduction and protection of Santa Clara Creek Watershed, involving Santa Clara Pueblo, Valles Caldera Trust, Forest Service, and others (2002)
  - Restoration and research on northern goshawk habitat, comparing different prescriptions, involving The Nature Conservancy, Valles Caldera Trust, Forest Service Regional Goshawk Working Group, Ecological Restoration Institute at NAU, University of Montana, FS Fire Sciences Laboratory, Four Corners Research Institute, and T.C. Company (2003)
  - Technical assistance to increase the capacity of CFRP multiparty monitoring groups, involving Ecological Restoration Institute at NAU, Rocky Mountain Research Station and the Forest Service (2003)
  - Thinning to reduce crown fire risk, increase water yield in riparian areas and process small diameter wood, involving Jemez Pueblo Walatowa Woodlands Initiative, Valles Caldera Trust, Forest Service, Bureau of Indian Affairs, Jemez Community Development Corporation, Los Alamos National Laboratory, NM Dept. of Forestry, WERC Pollution Prevention Technical Resources Center, Navajo Nation, and McNeill Technologies (2004)
  - Beaver habitat and riparian restoration, involving Santa Clara Pueblo, Valles Caldera Trust, local college students, Youth Conservation Corps and others (2007)

- 2008- Sandoval County Community Wildfire Protection Plan (CWPP), which assessed forest and fuel conditions that highlight the need for restoration in the SWJM area (Sandoval County 2008); plus the CWPPS for Greater Cuba Area, Los Alamos County, and Santa Clara Pueblo
- 2001-09- Respect the Rio and San Antonio Wetlands riparian restoration projects, which cover over 8,000 acres of riparian habitat in SWJM area, included a comprehensive public education program, and involved Valles Caldera Trust, Forest Service, NM Environment Department, Los Amigos de Valles Caldera, Stream Dynamics Inc., WildEarth Guardians, Boy Scouts of America, New Mexico Wildlife Federation, and others
- 2008-09- Climate Change Adaptation Report, which modeled ecological processes and recommended strategies to reduce climate change impacts by enhancing ecosystem resilience(TNC 2009), and tiered to the Statewide Climate Change Impact and Vulnerability Assessment that identified the Jemez Mountains area as a key area for monitoring climate change impacts in the Region (TNC 2008)

- 2010- Statewide Natural Resources Assessment, which analyzed ecological conditions and restoration needs, validating the urgent need for restoration in the SWJM area (State Forestry 2010)
- 2009-2010: SW Jemez Mountains Landscape Assessment and Valles Caldera National Preserve Existing Conditions Report, which described existing conditions, trends and departures from reference conditions for Forest and Preserve lands in the SWJM area, and included shared specialist reports and GIS data
- 2009-2010- NM Endemic Salamander Team and collaborators are developing protocols for protection of the Jemez Mountain salamander and its habitat while conducting forest restoration treatments.

Collaboration to Develop the Strategy.

Collaboration specific to the SWJM restoration strategy was clearly built on the foundations established for collaborative forest restoration in this area over the past 10 years. Then, starting in 2008, managers and staff from the Forest and Preserve met regularly to accelerate forest and watershed restoration in the SWJM area and lead development of a landscape strategy based on the Forest Landscape Restoration Act. Representatives from the New Mexico Forest and Watershed Institute (NMFWRI) and TNC joined in, and these four entities became the "lead restoration partners" group that led the collaborative strategy development process.

While the Forest and Preserve scientists completed assessments of the SWJM landscape conditions, the lead partners group completed a Collaboration Plan and reached out to potentially interested collaborators. Other collaboration actions completed in 2009-2010 specific to creating the SWJM strategy and proposal are summarized as follows:

- Met with many stakeholder groups, including industry and environmental groups, state agencies, tribes, counties, homeowners associations, and rural economic development groups
- Used phone calls and email exchanges to actively engage and dialog with over 15 government and 20 non-government organizations about the SWJM restoration strategy
- Developed and widely distributed a status report (newsletter) describing the SWJM restoration project and how to get involved
- Created and managed an interactive SWJM restoration website that includes draft documents and maps for public review, public comment forms, participation interest surveys, status reports, how to get involved, questions/answers, other weblinks, and more
- Conducted a field trip to demonstration areas and restoration challenge areas (Oct. 2009)
- Worked with adjacent land managers from Pueblos and Bandelier National Monument to partner on planning, implementing, and monitoring forest restoration treatments across administrative boundaries, where needed for the SWJM landscape strategy, and pulled their GIS inventory data into a centralized Forest database for this project
- Engaged leading southwestern forest ecology research scientists to help develop and review the strategy, ensure the use of best available science, and participate in implementing and monitoring the strategy, as part of a unique partnership between research scientists and land managers in the Jemez Mountains

- Held a 3-day facilitated workshop with over 60 participants representing over 30 different organizations, agencies and tribes; collaboratively developed a restoration vision of success, and restoration needs, goals, objectives, and identified and prioritized treatments and locations
- Formed smaller working groups that continued working together through April 2010 to complete the treatment strategy and cost analysis, wood products utilization analysis, multi-party monitoring plan, implementation and funding plans.
- Created a comprehensive multi-party monitoring strategy that includes many non-Forest Service partners who will have roles in monitoring the SWJM strategy, consolidating and evaluating data, identifying adaptive changes, and completing annual reports

Research-Land Management Partnership

Research scientists and land managers in this SWJM area have had a unique long-term partnership. Researchers continue to use this landscape for studies of fire history and behavior, climate change and hydrologic regimes, wildlife, forest ecosystem dynamics and related topics. Several researchers involved with this SWJM strategy are co-located with management agencies, such as Dr. Robert Parmenter, Director of Science and Education for the Valles Caldera Trust, Dr. Craig Allen, a USGS-Research Ecologist at Bandelier National Monument, Dr. Randy Balice, a fuels-modeling expert at LANL, and Dr. Todd Ringler, a climate scientist developing regional-level climate models at LANL. Other scientists from universities and institutes who conducted studies in SWJM and contributed relevant research and advice to the SWJM strategy include: Dr. Thomas Swetnam and Dr. Donald Falk-University of Arizona Tree Ring Research Lab; Dr. Esteban Muldavin-University of New Mexico Biology Dept; Dr. Brandon Bestelmeyer- NM State University (USDA-ARS-Jornada Exp.Range); Dr. Melissa Savage-Four Corners Institute and UCLA; and Dr. Kent Reid-NM Forest and Watershed Restoration Institute. Other scientists from the USDA-Fire Sciences Laboratory, Rocky Mountain Research Station, National Science Foundation, US Fish and Wildlife Services, TNC and others also use this landscape (and the Preserve's new Education and Science Center) as an outdoor laboratory for restoration-related research.

Summary

Past and on-going collaboration among very diverse parties is one of the unique strengths of the SWJM restoration strategy. The workshop stimulated group cohesion and a heightened level of collaboration, focusing on common goals for the Jemez Mountains. The on-going collaboration built a sense of trust, teamwork and unity around common set of forest and watershed restoration objectives, which yielded a consensus-based strategy for restoring the SWJM landscape. Partners invested considerable time and funding to contribute to this restoration strategy and are committed to continued involvement.

Scientific Methods

Introduction

Collaborators developed the restoration strategy, including identifying and prioritizing treatments, using the best available science. The strategy relied on numerous field-based natural resource inventories compiled into a GIS database system, along with peer-reviewed research publications, the latest vegetation analysis and fire behavior models, numerous

landscape-scale assessments of ecological conditions, trends, and threats, and the applied knowledge of local research scientists and resource professionals who have worked in this area for decades.

All that information was used to complete an in-depth analysis of current conditions, trends, threats, and ecological departures from reference conditions, forming the basis of the specific ecological restoration objectives and strategy. Current conditions and trends were compared to reference conditions, to determine the degree of ecological departure. Ecosystem reference conditions were defined by well-accepted research studies on historic conditions in Southwestern ecosystems prior to about 1900. For ecosystem attributes lacking historic data, such as water quality and wildlife habitat, reference conditions were characterized by Forest Plan standards and other federal land management standards from law, regulation, or policy.

Ecological departures for each ecosystem were evaluated considering the LANDFIRE Biophysical Setting (BpS), Forest Succession Class (S-Class), Historic Range of Variability (HRV), and Fire Regime Condition Class (FRCC). Departures for water quality conditions also relied on comparisons with the appropriate TMDL (Total Maximum Daily Load), which is the amount of pollutant a stream can contain while still supporting its designated use. When the TMDL is exceeded for any pollutant, it is considered "impaired". Departures in riparian vegetation relied on comparisons with "proper functioning condition" attributes for riparian vegetation and stream channel characteristics based on interagency riparian inventory protocol (USDI Bureau of Land Management 1998). Departures for aquatic/fisheries habitat were compared to desired attributes identified in the Forest Service Region-3 stream inventory handbook to quantify and rate aquatic condition as properly functioning, functioning at risk, or not properly functioning (Forest Service Handbook-FSH 2509).

Ecological *Assessment Reports* and supporting *SWJM Assessment Report Reference Documents* are available in the documents section of the SWJM restoration website. An extensive set of resource maps used to help develop the strategy are also available on the web, excluding the maps of threatened, endangered, sensitive species habitat and heritage resource site locations, which are not publicly distributed in order to help protect those species and sites.

Data Used

An abundance of data was collected and analyzed in a manner consistent with USDA-Forest Service protocols and national datasets, with model's such as LANDFIRE (Landscape Fire and Resource Management Planning Tools Project) and FLAMMAP (Finney 2006) used as tools, consistent with their accepted purpose and application. Specific data sets used to determine current ecological condition and departures included but are not limited to the following:

- Field-sampled resource inventory data collected on the Forest and Preserve using standard Forest Service protocols and entered into various Forest Service resource inventory database systems and a GIS spatial database. This includes comprehensive inventories completed for forest stand conditions, fuel and fuel models, wildlife habitat and species, invasive and rare plant populations, fish populations and species composition, roads and trails to designate or eliminate, heritage resource sites, and other resources.

- Forest- and Preserve-wide data on roads and trails, including the use of the INFRA database plus additional details from recent travel management analysis and plans.
- Water quality data collected on perennial streams by the New Mexico Environment Department, using standard protocols; stream measurements collected by the National Riparian Service Team; fish population and habitat data collected by New Mexico Department of Game and Fish, Forest and Preserve; streamflow discharge data from USGS stream gauges; riparian and stream inventories conducted by the Forest and Preserve, including use of standard Proper Functioning Condition and Hydrologic Condition survey protocols. See riparian, fisheries, and stream inventory reports on the Forest's website.
- Aerial insects and disease impact surveys conducted by the Forest Service Southwestern Region, along with field reconnaissance of selected sites.
- Soil, geologic, and vegetation data from the Terrestrial Ecosystem Survey database, covering the entire landscape area.
- LANDFIRE data products including vegetation composition and structure, surface and canopy fuel characteristics, and historical fire regimes (www.landfire.gov). LANDFIRE data products are created at a 30-meter resolution, designed to facilitate national- and regional planning, so it was carefully calibrated (adjusted) to more accurately reflect field-sampled data. LANDFIRE provides nationally consistent and seamless geospatial data products for use in wildland fire analysis and modeling and includes data on elevation, aspect, slope, fire behavior fuel model, canopy cover, canopy height, canopy base height, and canopy bulk density.
- FlamMap fire behavior modeling tools (Finney, 2006) were also used together with the LANDFIRE data to assess the distribution of potential fire behavior characteristics in the SWJM area. Fuels specialists from all levels of the Forest Service evaluated and compared LANDFIRE data to local field-sampled data and conducted additional field reconnaissance to further calibrate the model to actual vegetation and fuel conditions. (Details on file available upon request). FlamMap computes potential fire behavior characteristics over an entire landscape for given weather and fuel moisture conditions. Additionally, FlamMap was used to estimate burn probability. Burn probability, as used in FlamMap, is defined as the number of times a pixel burned as a proportion of the total number of fires simulated. Five thousand random ignitions were used in the simulations. Burn probabilities are related to the sizes and frequency of fires that occur on a given landscape.

Research and Science Reviews

Resource professionals from all levels of the Forest Service (District, Forest, Regional and National offices), the Preserve, many partner agencies and leading Southwestern ecosystem research scientists worked together to complete comprehensive assessments and comparisons of current and reference conditions to determine restoration needs for this SWJM landscape.

Those assessments were previously listed in the Collaboration section and are available on the SWJM restoration website.

The close partnership between research scientists and the Forest and Preserve managers is also discussed in the Collaboration section, including the names of key research scientists who contributed to this landscape strategy. Those scientists also reviewed the assessments and SWJM strategy to help ensure that it reflects the best available research and scientific methodologies for this type of strategic, landscape-level analysis and planning. Relevant, peer-reviewed, scientific literature was used as a basis for and cited in these ecological assessments, and those extensive bibliographies of literature cited are contained in the assessment reports and related documents on the SWJM restoration website.

Methods and Scales

Fire Regime Condition Class

Fire Regime Condition Class (FRCC) methodology was used to assess ecological departure for each forest ecosystem. FRCC analysis is a systematic process for identifying a reference condition[1] and evaluating the existing condition of vegetation composition and structure relative to the reference condition. FRCC represents the current ecological trend as measured by the composite of structure, composition, and processes across the landscape, providing a more holistic view of the current condition than a discussion of vegetation alone.

The FRCC analysis, conducted for this SWJM landscape by scientists at US Forest Service Fire Sciences Laboratory, used standard interagency methods and inputs such as the biophysical setting (BpS), succession class (S-Class), reference conditions, and landscapes (see details in FRCC and Fuels specialist reports or the assessment report on the website).

The timescale used in the FRCC analysis reference condition was the period prior to European settlement and fire exclusion (approximately the 1880s in this area). The assumption is that the reference period provides an indication of the natural range of variability in climate and fire disturbance regimes. The spatial scale is equally important, and the SWJM landscape provides a contiguous forested area large enough to include the variation of natural fire regimes among the representative BpS and S-Classes. The SWJM landscape is slightly smaller than the entire Jemez River Watershed [4^{h} level Hydrologic Unit Code (HUC)] and contains over two 5th level HUCs (Upper and Middle Jemez River) and over 10 smaller 6th level HUCs. The FRCC analysis evaluated BpS and S-Class relative amounts for the landscape and the S-Class relative amount for the 6th Level HUCs, to ensure departure metrics were not being weighted by any spatial anomalies. The relative amounts were similar at all scales.

For some finer-scale analysis on the Preserve, Watershed Management Units (WMUs) were additionally used, which are sub-units of the 5th level HUC, delineated using ArcHydro software. The Forest and Preserve resource specialists analyzed forest vegetation at the forest stand level

[1] Reference Condition: "the composition of landscape vegetation and disturbance attributes that, to the best of our collective expert knowledge, can sustain current native ecological systems and reduce future hazard to native diversity" (Hann et al 2008).

as well, for finer-scale analysis of conditions and trends. A forest stand is a contiguous area of similar tree species composition and structure, ranging from three to several hundred acres in size. Using this combination of coarse- and fine-scale data and methods allowed the Forest and Preserve staff to effectively evaluate and prioritize treatments in context with the surrounding landscape and associated ecological departures. The BpS and S-Class attributes were also applied at a forest stand level where needed for analysis appropriate to that scale. LANDFIRE and FRCC data were used for coarser scale trend analysis of ecological departures.

Wildland Fire Behavior and Risk

Wildland fire (wildfire) behavior and risk were assessed at the landscape scale using standard models considering the fuels, weather and topography. This analysis used forest fuels data (live and dead-down fuels) such as surface fuel models, crown fuel bulk densities, crown base heights, and fuel moistures. The FlamMap fire behavior model spatially displayed probable wildfire scenarios under fire weather conditions, as surface fire, passive crown fire, or active crown fire (passive and active crown fires based on degree of fire spread through tree crowns). Other data used included historic fire weather, weather during large fire events, historic fire ignition points locations, and historic fires. Outputs provided statistical probabilities of wildfire occurrence, size, type, and spread if a wildfire starts in this landscape. FlamMap outputs on fire behavior included data on predicted flame length, rate of spread, and heat intensity.

Historic weather data used in this analysis was accessed from Remote Automated Weather Stations (RAWS) through KCFAST and the Western Region Climate Center. Weather data was initially obtained from two RAWS stations in the Jemez Mountains, shown in table 12.2. Jemez station data was determined to best represent the landscape area while the Tower data was used for landscape calibration using FARSITE.

Table 12.2. RAWS Weather Stations Within or Near the SWJM Landscape

Station Name	Station Number	Record Period	Elevation (ft)
Jemez	290702	1966 - 2009	8000
Tower	290801	1964 - 2009	6500

FireFamilyPlus was used as a tool to assess probable fire weather conditions that would be correlated with a wildfire occurrence in this area (USDA Forest Service 2002, Stratton 2004). Historic fire weather was analyzed to determine wind and fuel moisture conditions during fire season. Energy Release Component (ERC) was used as an indicator of drought and fire potential, calculated from fuel moistures. FlamMap adjusts fuel moisture for each pixel of the landscape to account for aspect, elevation, slope and canopy cover. The adjustment is based on weather conditions preceding the analysis period, referred to as the conditioning period. The conditioning period was developed from data from the Jemez RAWS station. Wind speed and direction are direct inputs into fire behavior calculations. Hourly winds were assessed to determine direction and speed of predominant winds and the strongest winds recorded. WindWizard (Butler et al 2006) was used to model variability of wind speed and direction due to topography across the landscape.

PROBACRE was another wildfire risk assessment model used to analyze the probability of a large crown fire (over 4,000 acres in size) would occur in this landscape within the next 20 years. Results helped to assess and confirm results from FlamMap modeling.

Maps of watersheds, BpS, FRCCs, vegetation types, crown fire hazard and 40 others are available on the SWJM restoration website (http://www.fs.fed.us/r3/sfe/jemez_mtn_rest/maps.htm)

Aquatic and Riparian Ecosystems

Ecological departures were evaluated by comparing current conditions and trends to reference conditions or federal agency guidelines, in terms of species composition, structural conditions, and functional ecosystem attributes. This analysis considered each perennial and some intermittent streams (and 6th-level HUCs) in the area, including: Jemez River, East Fork Jemez, Rio Cebolla, Rio Guadalupe, San Antonio Creek, Jaramillo Creek, Redondo Creek, La Jara Creek, Rito de los Indios, San Juan Canyon, Vallecitos Creek, Sulphur Creek, and Virgin-Paliza Canyon. The team analyzed the degree of ecological departure in desired aquatic habitat conditions for attributes listed in the Forest Service Stream Inventory Handbook, such as: riffles, large woody debris, pool development, sediment, stream bank conditions, presence of native fish species (Rio Grande cutthroat trout, chub, sucker, and longnose dace).

Water quality in each stream or stream reach was evaluated in terms of meeting water quality standards in support of the stream's designated use, and specific causes and types of impairment were identified. Ecological departures were both quantitatively and qualitatively summarized, noting the primarily causes and pollution sources as well as the impacts or threats resulting from each departure.

Similar analysis methods were used to evaluate ecological departures for riparian, wet meadow and wetland ecosystems, assessing and comparing current to reference species composition, structural and functional attributes. Ecosystem attributes included FRCC, native plant community composition and trend, encroachment by invasive, exotic species (or conifers), and habitat condition in terms of suitability for northern leopard frog and New Mexico meadow jumping mouse, which are both sensitive species of high conservation concern in the western U.S.

Data used for these aquatic and riparian ecosystem analyses included an abundance of field-sampled data on water quality, aquatic/fish habitat, and riparian condition, including photographs and in-stream surveys, properly functioning condition surveys, and hydrological conditions assessments. Stream inventory and hydrologic conditions assessments for the major perennial stream systems in this landscape are available on the Forest's website.

Fish and Wildlife

The assessment of ecological departures included analysis of specific ecosystem attributes for fish and wildlife species and habitat. Wildlife survey data was available for most of the threatened, endangered, sensitive (TES) and game species in this area. Analysis of ecological departures included evaluating condition, trend, and threats for occupied and potential wildlife habitat for TES species and Management Indicator Species (mostly game species). Each ecosystem type was evaluated in terms of the associated species and habitat, including ponderosa pine, piñon-juniper woodland, mixed conifer, spruce-fir, aspen, grasslands, riparian and wet meadows, and aquatic ecosystems. Fish and wildlife habitat and species data was

coordinated and combined with data from US Fish and Wildlife Service and New Mexico Department of Game and Fish.

Habitat attributes used in this analysis included the relative amount of structural or S-Classes, uncharacteristic vegetation (such as conifer and invasive plant species in meadows, aspen stands, riparian communities), key wildlife habitat components (such as snags, downed logs, old growth), and degree of fragmentation or connectivity for wildlife migrations and genetic interaction.

Watershed and Forest Health

Other ecological attributes related to watershed or forest health were included in quantitative and qualitative assessments for each ecosystem (and watershed). These included assessing the soil erosion/landslide hazard (per Terrestrial Ecosystem Survey data), especially in areas with a high risk of crown fire occurrence (per FlamMap results). Where both risks are rated high to severe, then there is a significant threat to water quality, soil productivity, and overall watershed health. Forest health indicators included those previously described for the FRCC and wildfire risk analysis including S-Class relative amounts, as well as trends in insect and disease defoliation and mortality, using data from aerial surveys conducted over the past 20 years.

Ecological Context - Restoration Needs

The collaborators involved in developing this restoration strategy detailed the ecological case for restoration based on landscape assessments, scientific research, and other supporting documents and associated maps that illustrate how current ecological conditions significantly depart from historic reference conditions. These documents delineate how fire regimes in the Jemez Mountains have been radically altered since the 1880s, and the resulting forest ecosystems are in a precarious and unsustainable condition. Forest ecosystems in the SWJM area form an elevational gradient from high elevation spruce forests through moist and dry mixed conifer forest (north- and south-facing slopes respectively), transitioning into ponderosa pine forests and then to low-elevation piñon-

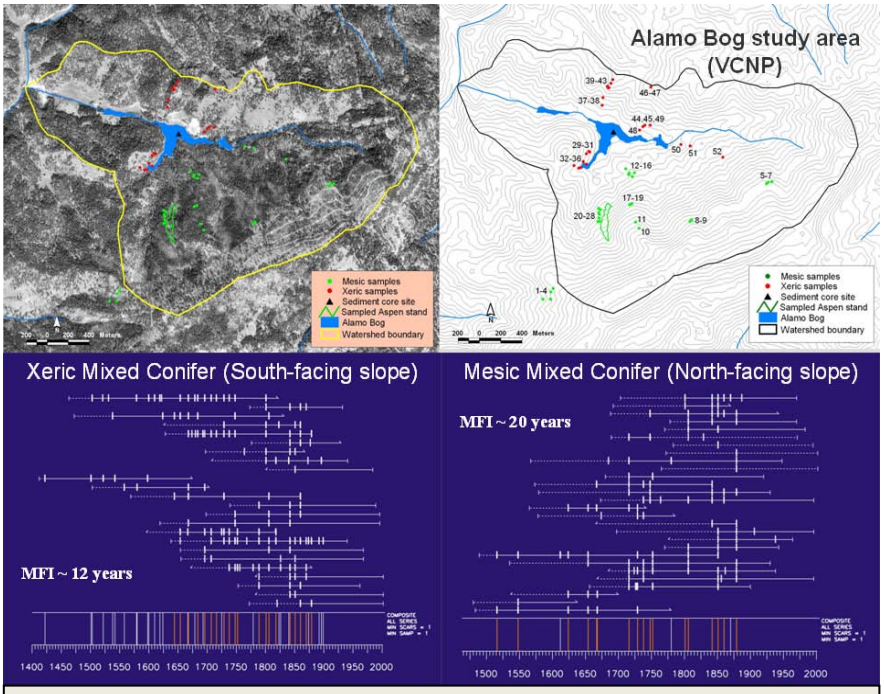


Figure 12.2. Fire histories of mixed-coniferforests (xeric and mesic) at a representative site in the Jemez Mountains, New Mexico, 1400 AD -

juniper woodlands. Elevations range from 11,200 feet down to 5,500 feet. Each forest ecosystem has its own natural composition, structure, and fire regime – but extensive research in the Jemez Mountains has shown that these forests have significantly departed from reference conditions.

Figure 12.2 illustrates historic fire frequencies in the area, from fire scar data collected on dry south-facing slopes (xeric) and moist north-facing slopes (mesic). Analyses by Dr. Craig Allen, USGS Jemez Mountains Field Station and colleagues at the University of Arizona show the salient patterns found throughout the Jemez Mountains. First, fires were much more common in drier mixed-conifer forests (mean fire interval of ~12 years) than in moist mixed-conifer forest (mean fire interval of ~20 years). Second, forest fires virtually ceased after about 1900. The reasons for this lack of fire are typical of the American Southwest – overstocking of livestock removed fine surface fuels (Fig. 12.3), and active fire suppression in the 20th Century prevented the spread of the many fires that were ignited (20-40 lightning ignitions per year).

Figure 12.3. Repeat photographs of Jaramillo Creek shows sheep impacts in 1935 compared to current conditions under controlled cattle grazing

Over 100,000 sheep per year grazed the area before 1939, and 6,000-12,000 cattle per year grazed from about 1939 to 1999. Livestock grazing still occurs in this area, although grazing in riparian areas is limited or excluded, and livestock numbers are greatly reduced (approximately 550 on the Preserve and 890 on the Jemez District per year, June-September). Limiting livestock grazing along streams has resulted in noticeable recovery of riparian areas. However, most streams in the area are still listed as "impaired" by the New Mexico Environment Department, and Total Daily Maximum Loads (TMDLs) have been issued for temperature (too warm) and turbidity (excess sediment).

In addition to historic livestock grazing problems, much of the SWJM area was logged in the early to mid-1900s. Most stands on the Preserve were clearcut using jammer-logging techniques, which required construction of over 1,200 miles of roads. Stands on the Forest were mostly selectively logged. At that time, the Preserve was a private ranch, and loggers there were not required to burn the slash or plant new trees. As a result, current forests on the Forest and Preserve consist largely of second-growth "dog hair" thickets of young ponderosa pine and white fir, averaging over 1600 stems per acre. These stands require considerable effort to restore via thinning and burning, yet such treatments are needed to successfully move them on a trajectory toward old growth. Figure 12.4 shows unroaded old growth forest around Redondo Peak on the Preserve before 1963, and how it looked after clearcutting and roading in the early 1970s, and how it appears today as second-growth forest with roads still evident.

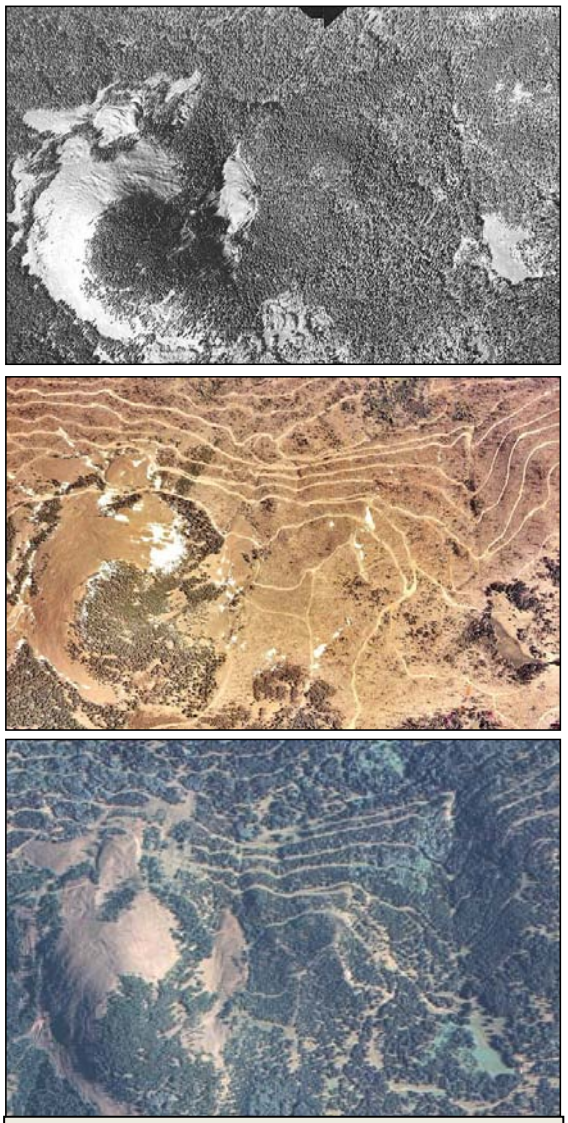


Figure 12.4. Repeat aerial photos of forest around Redondo Peak: old growth prior to harvest in 1963, clearcuts and roads after logging in 1975, and second-growth forest in 2005.

As a result of fire suppression and historic harvesting and grazing practices, nearly the entire forested landscape is in fire regime condition class (FRCC) 2-3, moderately to highly departed, which poses a serious risk of uncharacteristically large and intense wildfires and loss of key ecosystem components (see FRCC map). These arid forests were historically more open and clumpy than they are today. Over 80% of the ponderosa pine and 93% of mixed conifer are in a homogenous, mid-age, closed canopy state.

The ponderosa pine and dry mixed conifer forests that were dominated by large fire-resistant tree species are now dominated by small fire-intolerant trees. These forests have experienced a substantial decline in mature and old growth structures, open meadows, aspen, and understory grasses, forbs and shrubs. For example, the proportion of open-canopy old growth ponderosa pine forest is only 3% compared to over 60% historically. Over 98% of the ponderosa pine ecosystem is in FRCC 2-3 (82% in FRCC 3,16% in FRCC 2).

Hydrologic regimes (water cycles) are strongly influenced by the extensive second-growth, closed canopied forests. In the winter, these closed canopy forests intercept and suspend the snow above ground, subjecting it to increased sublimation (evaporative water loss). Researchers at University of Arizona measured sublimation losses in this area and estimated that 50% of the snow water equivalent is sublimated back to the atmosphere, which reduces water filtration into the soil. As a result of the increasing forest density and snow sublimation, water from historic springs and seeps has measurably declined or dried up entirely. Restoring this area to contain more open forest structure should increase spring snow-melt runoff by as much as 10%, with at least an equivalent increase in groundwater infiltration and recharge.

Soil erosion rates have also greatly increased as ground vegetation and water availability have severely declined. Loss of surface vegetation and increased soil erosion is especially excessive in overcrowded piñon-juniper woodland ecosystems, which have inherently high erosion rates. Soil erosion is also particularly problematic in riparian areas, mainly due to poor road crossings and heavy recreational uses, where it is a key contributor to water quality degradation. (See soil erosion hazard map)

Insect and disease pests increasingly result in tree mortality in forests within this landscape, as overcrowded forest conditions cause trees to be stressed and more susceptible to mortality from natural insect and disease outbreaks. Aerial survey data shows over 60,000 acres (over 40% of forested areas on this landscape) experienced significant defoliation or mortality from insects or diseases over the past decade. (Refer to insect and disease inventory map)

Wildlife habitat is degraded and declining for over 25 threatened, endangered or sensitive (TES) species that occupy or have potential habitat in the area. Native wildlife species that were adapted to more open and diverse forest conditions have drastically declined and current conditions indicate a high risk of a large high-severity wildfire (over 10,000 acres in size) that would result in a long term loss of forested habitat.

Meadow and grassland ecosystems once maintained by frequent low-intensity fires are being invaded by conifer trees (Fig. 12.5). Lack of fires has also resulted in declines in aspen stands, which were also historically regenerated by fires.

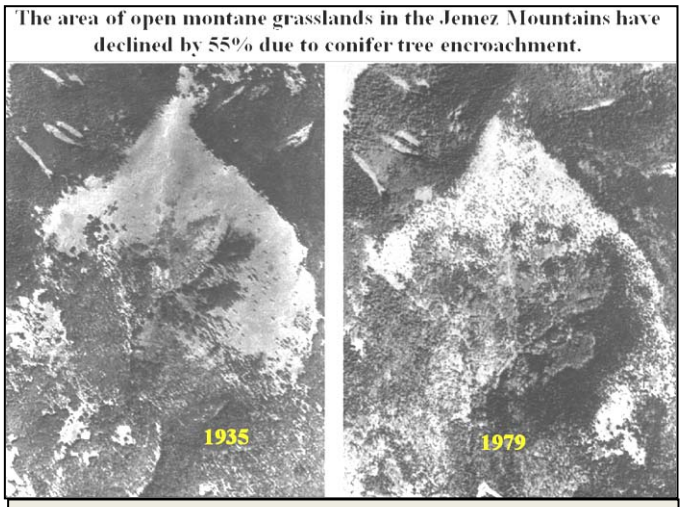


Figure 12.5. Repeat aerial photographs of a typical Jemez Mountain ridgetop grassland, increasingly being lost to conifer tree encroachment.

Riparian ecosystems, including large wet meadows, are severely degraded and impacting water quality and important TES fish and wildlife habitats, primarily due to recreational uses, roads, grazing, invasive plants, and conifer encroachment. Invasive plant species dominate over 1,400 acres of NFS-Forest land (10 different species), primarily within riparian ecosystems. On the Preserve, 10% of the 550+ species of plants are non-native. (See invasive species locations map)

Road density is excessive in parts of the area where it averages 3 to 6 miles per square mile. Over 1,200 miles of primitive roads on the Preserve and 400 miles on the Forest are in excess of minimum road needs and adversely impacting streams, wildlife, and other resources. Many are in poor condition and cross drainages without adequate stream protection. Most of the 96 miles of perennial streams in the area do not meet water quality standards, with primary concerns being excess sediment and temperature. They also do not meet federal guidelines for stream and fish habitat conditions, primarily due to an excess of sediment in riffles, insufficient pool development, and lack of large woody debris. Native Rio Grande cutthroat trout have been extirpated, and the Rio Grande chub and sucker have declined, largely due to the non-native (invasive) rainbow and brown trout. The highly altered forest vegetation and hydrologic regimes have reduced the quality and abundance of water that is so critical, not only to the wildlife and natural resources in the area but also to the cities and towns downstream. (See roads map)

The Jemez Mountains have experienced significant warming and drying trends over the past 100 years (Figures 12.6-12.8). Data from on-going climate change research in this area shows summer temperatures increasing faster than winter temperatures, resulting in longer and warmer summer wildfire seasons (Fig. 12.7-12.8). Precipitation exhibited a cyclic pattern that appears to mirror the Pacific Decadal Oscillation, with peaks and troughs becoming lower over time (Fig. 12.9). The cycle ranges from 50-60 years, with 25-30 year wet/dry phases. Thus, the Jemez Mountains may remain in the current dry phase for another 15-25 years before returning to average levels.

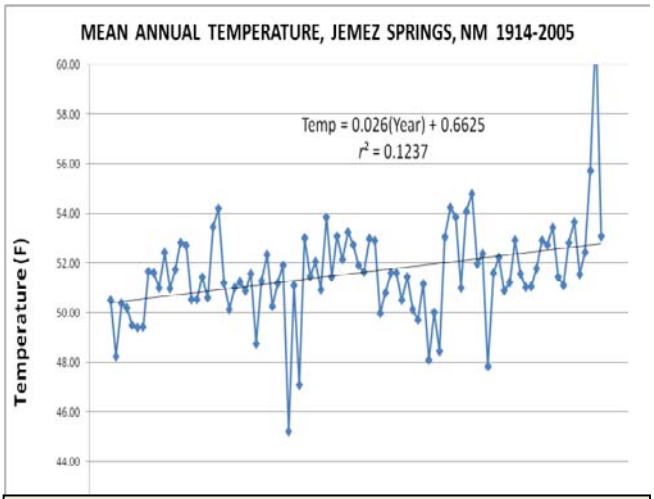


Figure 12.6. Mean annual temperature records for Jemez Springs, 1914-2005 show a warming trend.

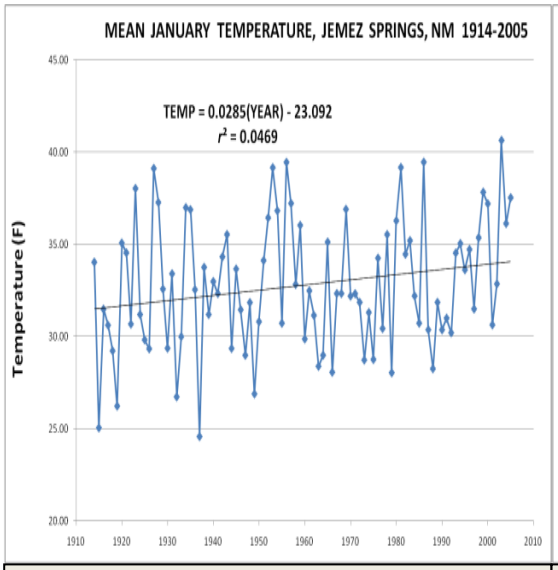


Figure 12.7. Mean mid-winter (January) temperatures, Jemez Springs.

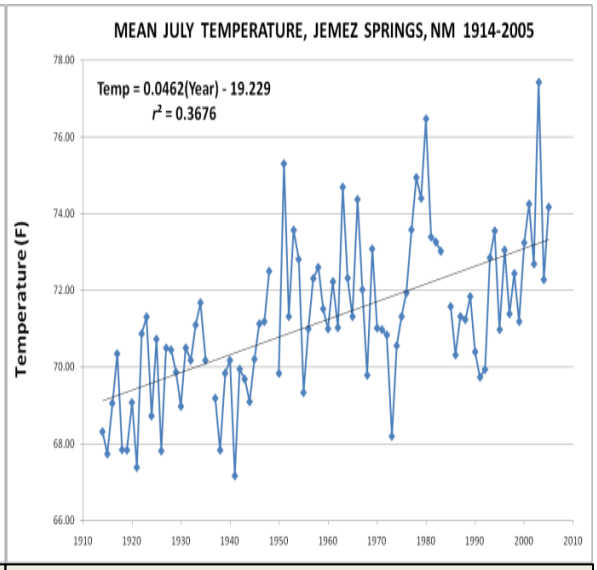


Figure 12.8 Mean midsummer (July) temperatures, Jemez Springs.

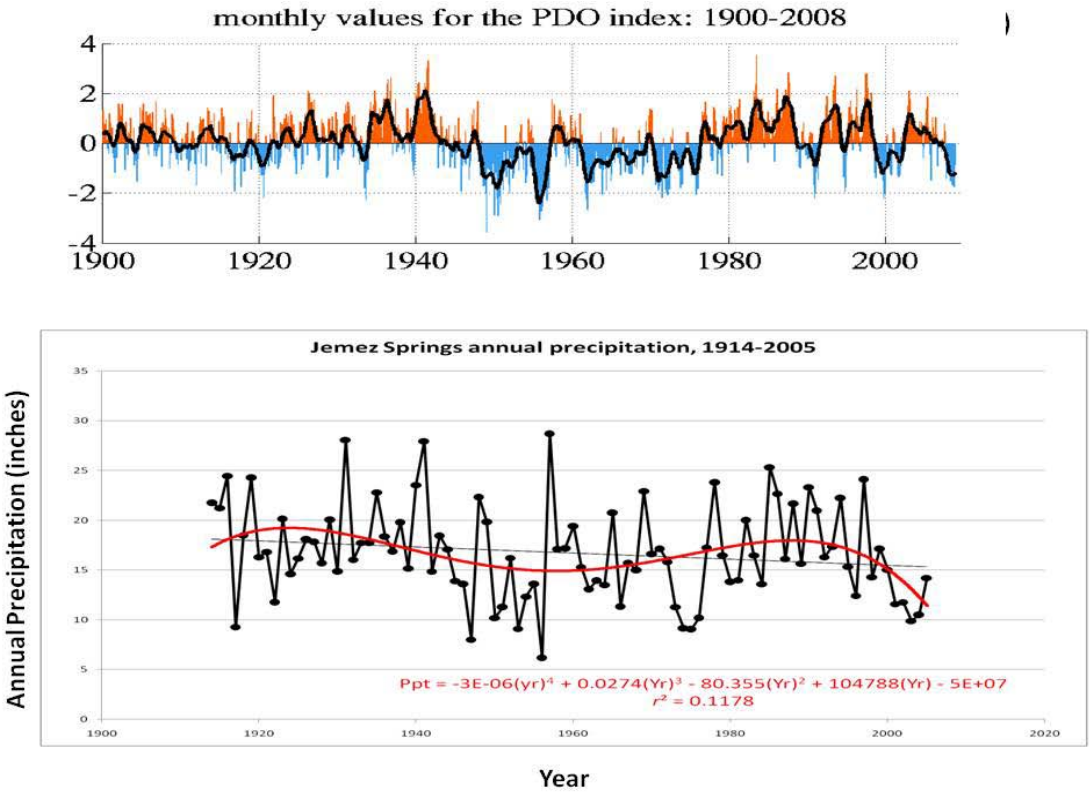


Figure 12.9. Precipitation records from Jemez Springs, with Pacific Decadal Oscillation index.

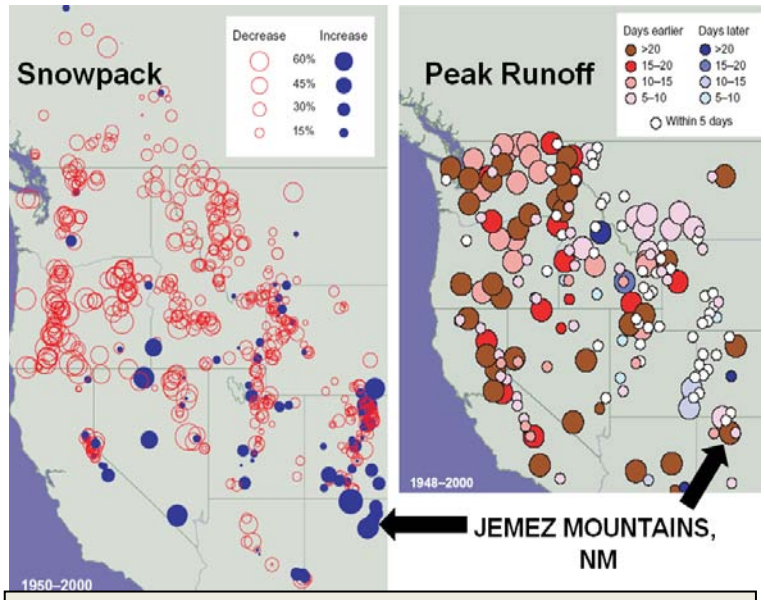


Figure 12.10. Snowpack and snowmelt patterns during the second half of the 20th Century.

These changes in precipitation and temperature have led to substantial changes in snowpack and spring snowmelt (Fig. 12.10).

Snowpack in north-central New Mexico has actually increased over the past 50 years, but at the expense of summer precipitation (which has declined). With warming spring temperatures, snowmelt is occurring earlier. The effects (lower summer precipitation, earlier snowmelt) act in concert to extend and amplify summer forest fire conditions, and influence surface stream runoff.

Stream gauge measurements of stream flows in the Jemez River show reduced flows, which are likely the result of less precipitation coupled with increased stand density and snow sublimation (Fig. 12.11).

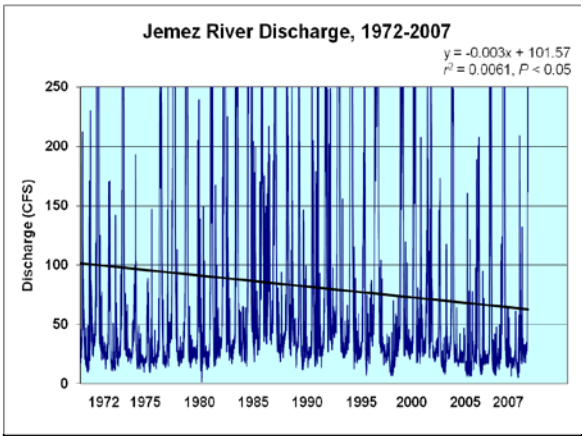


Figure 12.11. Surface flow rates on the Jemez River at the USGS gauge in Cañon, NM. Trend line shows average flows declined by

This landscape has been ranked as a top priority for restoration by a variety of groups and ecological assessment reports. A State-wide Climate Change Vulnerability Assessment identified the Jemez Mountains area as having both a high exposure to climate change impacts and high density of species vulnerable to climate change compared to other parts of New Mexico (TNC 2008). Documented trends involving larger than normal wildfires, bark beetle outbreaks, forest dieback, and wildlife population declines may be exacerbated by climate change impacts.

The Southern Rocky Mountains Eco-Regional Assessment identified the Jemez Mountains as a critical conservation area for preserving the region's biological diversity (TNC 2000). The State's Unified Watersheds Assessment classified this Jemez Watershed as a Category 1- in most urgent need of restoration (NMED 2005). The Sandoval County Community Wildfire Protection Plan identifies several "at-risk communities" in the SWJM area and ranks the area as a top priority for reducing the risk of uncharacteristic wildfire (Sandoval County 2008). The Statewide Natural Resources Assessment analysis and maps also show natural resources in this area at high risk and rank this area as a top priority for restoration in the State (NM State Forestry 2010).

Old growth ponderosa pine forests with relatively open canopy structure that historically dominated this area are virtually absent. Active fire suppression in this area has resulted in ponderosa pine and dry mixed conifer forests being heavily invaded by shade-loving white fir. This has converted most of this landscape from open forest dominated by large pines to closed stands that mimic moist mixed conifer assemblages and fuel loads. Moist (mesic) mixed-conifer forest has a historically lower fire frequency (previous Fig. 12.2). Frequent surface fires used to run up the south-facing slopes to the ridgetops. Fire suppression has increased fuel loads on the hot, dry south facing slopes that used to only occur on north-facing slopes (Fig. 12.12).

Figure 12.12. Jemez Mountains photo looking north shows abnormally dense forests on south-facing slopes that were historically dominated by low density ponderosa pine stands.

This situation is a recipe for high-intensity, stand replacement wildfire,

much like the 2000 Cerro Grande fire that burned adjacent lands in the Jemez Mountains, destroying a significant portion of the city of Los Alamos (Fig. 12.13). Few trees in that area survived and the area continues to be dominated by shrubs rather than trees. Forest conditions in the SWJM area are comparable to those in the pre-Cerro Grande fire landscape. Fire behavior models show a high probability of a large stand-replacing fire occurring in the area within the next 20 years, and the majority of the Forest lands within the SWJM landscape is in a wildland urban interface (WUI) due to the prevalence of residential communities and public infrastructure within the area. One of the major goals of the SWJM restoration strategy is to avoid a repeat of this devastating fire. (See FRCC and crown fire risk maps)

Figure 12.13. Photo showing the aftermath of the Cerro Grande Fire

Restoration Goals and Objectives

Restoration goals and objectives that drove development of the SWJM landscape restoration strategy are listed in the text box that follows. They were developed in light of the *Ecological Context* just described. They are consistent with goals and objectives collaboratively developed in the past by many of the same collaborators, such as the goals and objectives in: New Mexico Forest Restoration Principles (2006), Jemez Fire Learning Network Results (2003), Jemez Watershed Restoration Action Strategy (2005), Sandoval County Community Wildfire Protection Plan (2008), and similar ecological assessments of this area. (Those documents, including "out of whack" summary tables for each ecosystem, and others that support the ecological trends described in this proposal, are available on the SWJM restoration website). The SWJM strategy also includes goals and objectives in federal laws and policies such as the Healthy Forest

Restoration Act and Initiative (HFRA, HFI Field Guide) and the Omnibus Public Lands Management Act-TitleIV-Forest Landscape Restoration Act.

Forest restoration involves improving ecosystem resilience, which means increasing the ability of forest ecosystems to adapt to natural disturbance events such as wildfires, insect and disease outbreaks, and climate change impacts. The key to meeting this restoration goal is to diversify current forest structure and composition, shifting ecosystem conditions closer to what was historically sustained under natural wildfire regimes. Reaching this goal also involves reducing land use impacts from roads, recreational uses, livestock grazing, and invasive plant species.

***Goal**: improve the resilience of ecosystems to recover from wildfires and other natural disturbance events in order to sustain healthy forests and watersheds for future generations.*

***Objectives**:*

- *Reduce the risk of uncharacteristic wildfire*
- *Restore natural fire regimes*
- *Increase forest diversity and old growth characteristics*
- *Improve fish and wildlife habitat*
- *Improve water quality and watershed functions*
- *Mitigate climate change impacts*
- *Utilize woody by-products*

Restoration goals and objectives and the associated treatment strategies were derived by reviewing results of comprehensive landscape assessments and research studies conducted in this area on fire history, vegetation dynamics, hydrologic conditions, and climate change. Studies have found that ecosystems throughout this area have been radically altered by past livestock grazing, logging, and fire suppression. In particular the ponderosa pine and dry mixed conifer forests that were adapted to thrive under frequent surface fire regimes are now at risk of being decimated in a high-severity crown fire. Forested ecosystems are currently dominated by dense thickets of pole-size trees (5-16 inches in diameter), and are lacking in understory grasses and plants, large, thick-barked pine trees and old growth. As a result, biological diversity has substantially declined, and the area is at high risk of experiencing a large, destructive crown fire. Land managers and research partners agree on the urgency in restoring more natural ecological conditions in this area.

Reconstructed historic reference conditions were used as a guide for determining restoration needs, as previously described in this document, in Ecological Context and Scientific Methods.

Treatment Strategy and Actions

The highly diverse mix of collaborators first developed a holistic vision of the restoration strategy, considering the entire contiguous multi-jurisdictional landscape and all restoration objectives and needs identified. The groups identified specific restoration treatments and prioritized treatments and locations on the landscape.

This section describes the proposed treatments that constitute this SWJM landscape restoration strategy and proposal. Table 12.4 displays a summary of these proposed treatments, including the quantities and land jurisdictions associated with each treatment action. Additional details on prioritization, locations and scheduling of treatments over the 10-year period are shown later in this report in tables 12.7 -12.8. Figure 12.16 spatially displays the proposed restoration treatment areas on a map.

Thinning and Prescribed Fire Treatments

All forested ecosystems in this landscape will be treated to successfully restore this entire large, contiguous forested landscape. Beginning with an emphasis on ponderosa pine and dry mixed conifer forests, dense forests will be mechanically thinned in irregularly-spaced patterns using chainsaws, masticators, or feller-buncher equipment. These actions will reduce excess tree densities and shift species composition and structural characteristics toward the desired reference conditions and fire regime condition class (FRCC-1), to meet the restoration goals and objectives previously outlined. Several different thinning and burning methods, prescriptions, and design criteria will be used depending on area-specific objectives. Proposed treatments will break-up large areas of continuous closed-canopy mid-age forest and increase structural and age-class diversity while also reducing the density of small trees growing under larger trees to reduce the potential for surface fire to move into the tree crowns.

Priorities were developed for forest thinning and burning treatments, starting with forested ecosystems and stands that are the most highly altered from historic conditions, which are mostly in ponderosa pine and dry mixed conifer forest stands identified in FRCC 2-3. Prioritizing criteria included stands with highly altered density and structure, such as stands on south-facing slopes that were historically more open. Prioritization of treatment locations was done to mimic historic fire patterns that occurred in this area, focusing on the high density stands on dry south-facing slopes, from the low elevation woodlands to high elevation forests and ridgetop grasslands. Less thinning will occur on the moist north-facing slopes, especially in canyon bottoms and high elevation spruce-fir forests where existing forest conditions and FRCCs are closer to historic conditions. Proposed thinning treatments are strategically located to create a mosaic pattern that resembles historic fire regimes, while providing fuel breaks that will facilitate prescribed burning and management of natural (unplanned) ignitions. Priority treatment locations are also based on protecting at-risk communities, public infrastructure and domestic water supplies identified in the Community Wildfire Protection Plan (Sandoval County 2008). Additional prioritizing of thinning and burning treatments is aimed at meeting wildlife habitat improvement needs, such as to regenerate aspen, enhance mast production, improve woodlands, restore historic meadows, and reduce forest density near springs and headwaters.

Merchantable woody biomass will be removed for utilization where feasible. Anticipated volumes and merchantable wood products to be removed are described in the Utilization section of the Proposal. Utilization of woody by-products is one of the objectives of this strategy. It will not only provide social and economic benefits, it will reduce the amount of prescribed burning needed and smoke produced in this area, and wood product values will reduce (off-set) thinning costs, allowing more restoration work to be accomplished while saving money. Where wood product removal is not feasible, the felled logs and masticated wood will be left on site where they will be ecologically utilized to increase soil nutrient cycling and moisture, control soil erosion and invasive plants, and increase down log habitat for wildlife and microorganisms.

Prescribed burning will be conducted in conjunction with mechanically thinning treatments, in all thinned areas. First, residual thinning slash (non-merchantable woody fuels) will be cut-and-scattered, piled, or left in place. Once it is dry, it will be burned in small piles or in a broadcast burn, thereby reducing accumulations of fine fuels while recycling nutrients back into the soil. The broadcast burning will be relatively low-intensity and typically not burn the standing trees or

consume the downed logs left on site to benefit wildlife and watershed conditions. On some sites, such as bare soil areas under high-density piñon-juniper woodland stands, slash may be left in place for a longer period of time without burning, to reduce soil erosion, increase soil moisture, and promote the growth of understory ground vegetation.

Prescribed burning alone, without mechanical thinning pre-treatment, will be used wherever it is feasible and safe. Low intensity burning treatments (typically less than 4-foot flame lengths) can be used in areas that have been effectively thinned or are naturally open, to reduce excess surface fuels, seedlings and saplings; stimulate reestablishment of understory grasses, forbs and shrubs; create firelines or fuelbreaks; regenerate aspen; and reduce conifer trees in meadows and grasslands. Prescribed burning alone will also be applied using a mixed intensity prescribed fire in areas that are inaccessible or infeasible for mechanical thinning and have adequate fire lines and fuel breaks around them. Like the mechanical thinning method, a mixed intensity prescribed burn will thin stands and modify the forest structure, reduce ladder fuels (raise crown to base heights), regenerate aspen and meadows, and create a patchy, clumpy, mosaic forest structure. This burn method will mostly occur in higher elevation moist mixed conifer and spruce-fir forest ecosystems where natural wildfires occurred less frequently and with mixed-intensities. All prescribed burn ignitions may be applied manually or aerially (from planes or helicopters).

Natural fire ignitions (lightning) will be managed as prescribed fires in some areas under specific fuel and weather conditions determined to be both safe and consistent with restoration objectives. The continuously dense forests and communities currently limit or preclude management of natural fire ignitions in this area. However, as more of the landscape is restored, natural fire ignitions may play an increasingly greater role in meeting ecosystem restoration objectives, while reducing fire management and suppression costs. All burning requires site-specific burn plans and prescriptions, smoke management plans and permits, and must meet other rigorous standards to minimize smoke build-ups and protect human life and property.

Meadow, grassland, riparian, and aspen ecosystems will also experience thinning and prescribed burning treatments where needed to reduce conifer encroachment and restore historic ecosystem composition and structure.

Periodic maintenance burns along with management of natural fire ignitions will be used to retain restored conditions, with frequencies based on reference condition guidelines for each ecosystem (approximately 1 to 2 times per decade in ponderosa and dry mixed conifer forest ecosystems in the Jemez Mountains). It is very important to continue using fire to reduce the accumulations of fine fuels and conifer seedlings, and maintain resilient ecosystems.

Figure 12.14 shows a typical doghair stand in this area in contrast with an on-going thinning operation, a thinned stand after a couple years, and restored stand with mature trees and an herbaceous understory of grasses.

Figure 12.14. Photos show a typical *doghair* thicket, a thinning operation in 2005, the same stand after thinning, and an old growth stand.

Riparian and Aquatic Ecosystem Treatments

Riparian and aquatic ecosystem restoration involves a wider range of treatment actions, located in various stretches along stream corridors, and in wet meadow and wetland ecosystems. Riparian restoration treatments are strategically located to address areas of severe stream or riparian/wet meadow degradation, especially areas currently or historically supporting TES fish, amphibians, birds, and small mammals. Major stream systems in the area are displayed in the following map (Fig. 12.15) and stream miles on NFS lands are shown in Table 12.3 (excluding stream miles through private land).

Riparian –aquatic ecosystem restoration actions will be strategically located and prioritized in stream reaches that are the most highly impacted or show the greatest departure from reference conditions. Proposed riparian treatment acres and actions are included in Tables 12.4 and 12.7, and shown spatially on a map in Figure 12.16. Riparian ecosystem restoration treatment actions include:

- Rehabilitating denuded sites in riparian areas where vegetation has been removed by human activity or livestock. This involves a combination of erosion and sediment control and revegetation methods, such as seeding, mulching, planting native riparian vegetation and installing erosion/sediment control materials.

- Eliminating unneeded roads and trails in riparian areas and stabilizing roads and trails, especially at stream crossings
- Stabilizing streambanks with native material and erosion control features or vegetation
- Planting native riparian vegetation such as willows, alder, and shrubs
- Adding in-stream structures and large woody debris to reduce velocities and develop pools
- Reintroducing native Rio Grande cutthroat trout in designated stream reaches, starting with a 4-mile reach along East Fork Jemez River. Additional locations may be added in the headwaters in the Preserve after habitat quality has been restored and where it is feasible and desirable to remove non-native brown and rainbow trout.
- Installing riparian exclosure fences or barriers to limit access by cattle, elk or people; and using educational materials and other methods to discourage camping, driving and parking activity in riparian areas.
- Eliminating old, deteriorating earthen water tanks, or repairing, replacing, or installing new water sources to improve water quality, riparian areas, and wildlife habitat

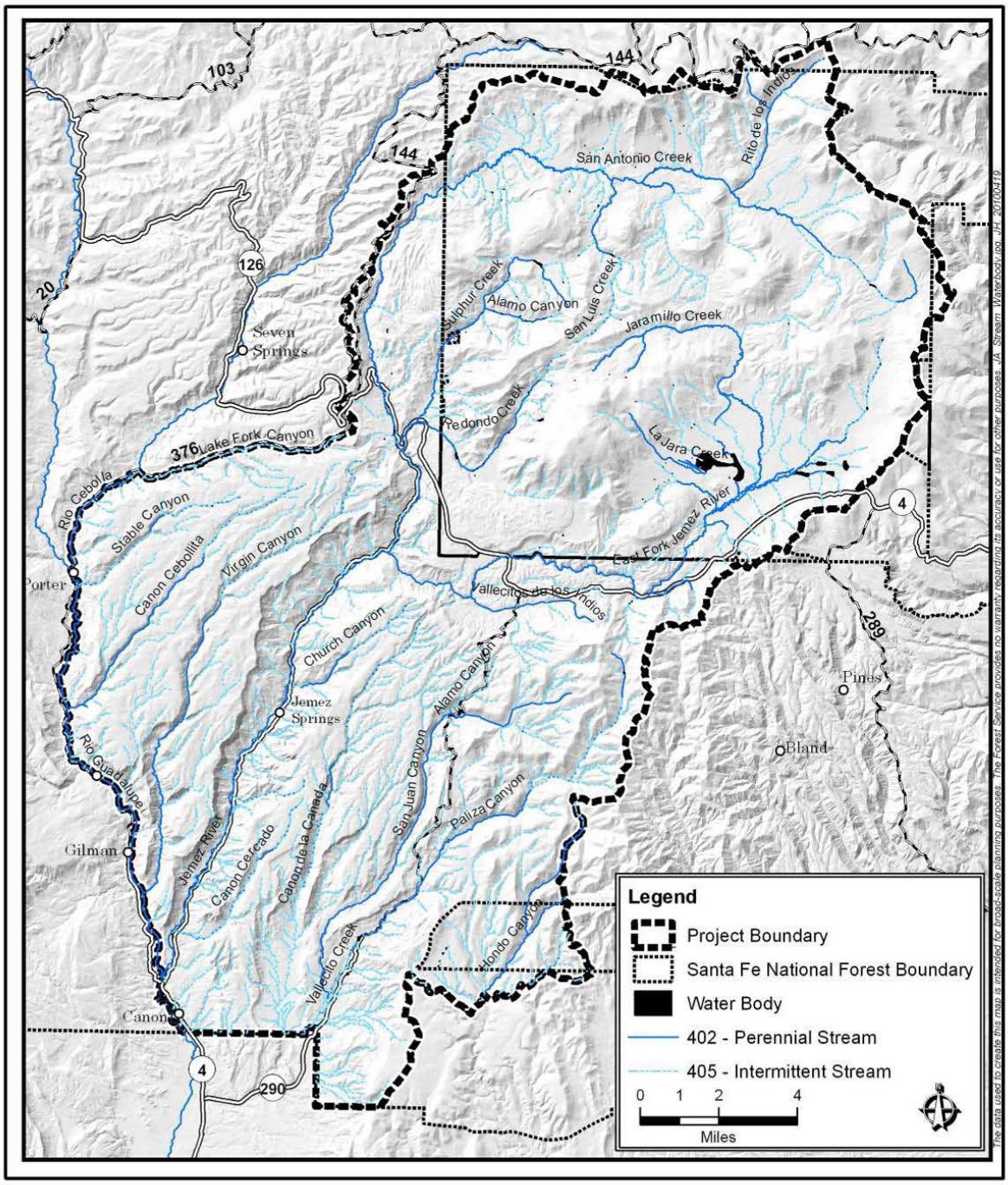


Figure 12.15. Streams and Waterbodies in the SWJM Landscape Area

Table 12.3. Stream Miles on Forest and Preserve Land in the SWJM Area

Streams on Forest Land	Miles	Streams on Preserve Land	Miles
East Fork Jemez River	11	East Fork Jemez River	10
Jemez River	7	Jaramillo Creek	12
San Antonio Creek	10	San Antonio Creek	19
Rio Cebolla	3	Redondo Creek	5
Rio Guadalupe	11	La Jara Creek	5
Paliza-Vallecito	14	Sulphur Creek	5
		Rito de los Indios	4
		San Luis Creek	4

Invasive Plant Control

Invasive exotic plants will be controlled through a combination of manual, mechanical, and chemical herbicide methods. Treatments will be designed to reduce the over 1400 acres of invasive plants known to occur on Forest lands in the area plus newly discovered invasive plants. Invasive plants will be treated on the Preserve as well, although there are fewer untreated populations remaining on the Preserve, consisting primarily of thistles and bindweed. Invasive plants such as Siberian elm, Russian olive, and tamarisk are prevalent and of highest concern in the riparian areas on the Forest's lower elevation streams. Treatments will be completed in accordance with the NEPA documents addressing invasive plant control along the Jemez River as well as the Forest-wide EIS (revised decision expected this year). Non-native aquatic plants in streams will also be controlled during implementation of aquatic ecosystem restoration treatments. We will work with willing landowners and partners (State, NRCS, and SWCD) to reduce invasive plants on intermixed private lands.

Additionally, project implementation will include methods to reduce the potential for introduction or spread of invasive plants, such as by requiring pressure washing of vehicles and equipment before they enter NFS lands to conduct treatments.

Wildlife Habitat

Improving wildlife habitat was an important factor in strategically locating and prioritizing the thinning, prescribed burning, and riparian restoration treatments in each ecosystem. The thinning, burning, and riparian zone activities previously identified include specific wildlife habitat improvement methods and locations, such as to regenerate aspen, restore meadows, thin around springs and headwaters, thin in piñon-juniper woodlands, enhance mast production, and remove non-native invasive species. Some of the restoration treatments are aimed specifically at improving habitat for threatened, endangered and sensitive (TES) species, by designing

them to address objectives in recovery or conservation plans. Treatments in mixed conifer habitat will include objectives to enhance habitat for (and avoid adverse impacts to) Mexican spotted owl and Jemez Mountain salamander. Treatments will improve habitat for northern goshawk and other species associated with ponderosa pine ecosystems. Riparian restoration treatments will improve habitat for New Mexico meadow jumping mouse, beavers, northern leopard frog and other riparian-dependent species, including other bird and small mammal species listed as sensitive species. Treatments include restoring aspen, meadow, and grassland ecosystems as well as forests and woodlands to improve biological diversity and habitat conditions for a wide range of native wildlife species, including wild turkey, deer, and elk. All restoration treatments in this strategy will be designed to meet the wildlife-related standards and guidelines in recovery and conservation plans for TES species and in the Forest Plan.

Old Growth

Old growth characteristics will be maintained or enhanced through treatment designs and locations. The number of trees over 18 inches in diameter within this landscape is substantially lower than in the pre-fire-suppression era (before the late 1800s). Thinning treatments will be designed to retain the large trees, logs, and snags (dead standing trees), and emphasize retention of fire-resistant species like the thick-barked ponderosa pine and Douglas fir species. Treatment prescriptions will be consistent with old growth management guidelines in the Healthy Forest Restoration Act and Initiative (HRFA, HFI) implementation guide. Research on managing old growth ponderosa pine is on-going in the Research Natural Area in this SWJM area, and results from studies in this RNA and other research sites in the area will be used to adjust the prescriptions used in this strategy as needed to help restore pre-settlement old growth conditions.

Roads and Trails

Existing roads and trails (routes) will be used to implement this strategy. No new permanent travel routes will be constructed. Any temporary routes built to implement this strategy will be decommissioned after use. Some roads that are needed to implement this strategy will be improved, such as by blading the surface, installing drainage control features, widening, or realigning the route, in accordance with federal road engineering standards.

The strategy also includes decommissioning unneeded routes, and closing some routes from public access if they are only needed for administrative purposes or private land access. Eliminating the excess public travel routes is strategically prioritized based on the degree of impact to riparian/wet meadows, water quality, TES fish and wildlife habitat, heritage resources, and congressionally designated areas. Roads to be retained will be improved and maintained to reduce ecological impacts, and some will be upgraded to be used for wood product removal. The Preserve has over 1200 miles of excess roads, mostly from past logging of this once privately-owned area. About 150 of those miles will require full decommissioning and the others can be blocked and allowed to naturally rehabilitate. There are approximately 400 miles on the Forest land in the SWJM area that are identified for decommissioning or closure, as identified in the forest-wide travel management plan (proposed action in draft EIS, expected to be finalized in 2011).

Non-NFS Lands

This strategy includes treatments not only on NFS lands on the Forest and Preserve, but also on adjoining Jemez Pueblo, Santa Clara Pueblo, and Bandelier National Monument (Bandelier) lands. Some of the thinning, burning, and riparian ecosystem restoration overlaps between NFS and non-NFS boundaries. These treatments on non-NFS lands are important to include in this landscape strategy, primarily due to the highly altered (FRCC 2-3) ponderosa pine and dry mixed conifer forests that overlap administrative boundaries, and the fact that a fire ignition in the SWJM area could quickly spread by prevailing canyon winds into the Pueblo, Bandelier, city of Los Alamos, and the Los Alamos National Laboratory lands. Other reasons these were prioritized to include with this strategy involved logical fuelbreak locations, scheduling and other factors.

Additional restoration treatments are anticipated to occur on 50-500 acres of private properties scattered among the NFS land in the area, through partnerships with willing landowners, State Forestry, the National Resource Conservation Service (NRCS) and local Soil and Water Conservation District (SWCD). Such treatments have successfully occurred on over 50 private properties in this landscape over the past 10 years, primarily around the Thompson Ridge and Sierra de los Pinos subdivisions.

Treatment Prioritization and Summary

Treatments were identified and then prioritized based on the ecological context and restoration needs such as the need to move from FRCC 2-3 toward FRCC 1 and to mimic historic fire regimes in Jemez Mountain ecosystems, as previously described in treatment descriptions. Priorities were also based on addressing wildlife habitat improvement needs, especially for TES species, along with the need to restore clean and abundant water in degraded watersheds, and need to protect at-risk communities and WUI areas identified in the CWPPs. The primary criteria used in prioritizing treatments for each ecosystem (including aquatic and riparian ecosystems) was the degree of departure from reference conditions, treatment feasibility, and expected effectiveness. The "out of whack" summary tables were used as a guide in prioritizing treatments, as they indicate the degree of departure from reference conditions for each ecosystem.

The following table displays the treatment activities and total "net" acres or miles to be actively treated over the entire 10-year period. These *net* treatment amounts were used to calculate treatment costs (per acre or mile) and merchantable wood removal opportunities (see Wood Utilization section). Additional acres will be included in the blocks of land treated (or thinning contracts) because not every acre within a treatment block will be actively treated. Localized sites within larger treatment project areas may not require treatment action or may need to be avoided in order to protect an archaeological site, TES nesting site or other feature. Thus, the total area considered restored after treatment will be greater than the net acres and stream miles shown in this table. This table identifies the type of treatment action rather than the purpose of each action, which includes improving wildlife and fisheries habitat, enhancing water quality and watershed conditions, enhancing old growth development, and other objectives.

Table 12.4. Treatment Type, Amount, Jurisdiction and Activity Description

Treatment Type	Amount	Jurisdiction	Activity Description
Thin, Remove, Burn (ac)	53,029	Forest	Irregularly thin stands, remove merchantable wood, prepare and burn slash
Thin, Remove, Burn (ac)	8,880	Preserve	
Thin, Remove, Burn (ac)	310	Bandelier	
Thin, Remove, Burn (ac)	370	Jemez Pueblo	
Thin, NoRemove, Burn (ac)	18,080	Forest	Irregularly thin stands, prepare and burn slash
Thin, NoRemove, Burn (ac)	7,504	Preserve	
Thin, NoRemove, Burn (ac)	2,230	SC Pueblo	
Burn Only (ac)	27,410	Forest	Mostly low intensity surface burns in treated or open areas; some mixed intensity burn in untreated stands
Burn Only (ac)	41,500	Preserve	
Burn Only (ac)	3,830	Bandelier	
Burn Only (ac)	3,400	Jemez Pueblo	
Riparian Rehab Actions (ac)	245	Forest	Rehabilitate bare soils, stabilize streambanks, reduce conifer encroachment, plant riparian vegetation
Riparian Rehab Actions (ac)	55	Preserve	
Riparian Rehab Actions (ac)	60	SC Pueblo	
Riparian Exclosures (mi)	10	Forest	Construct exclosure fences (or barriers) to limit cattle/elk access and use
Riparian Exclosures (mi)	5	Preserve	
Aquatic Structures (mi)	24	Forest	In-stream structures (logs, boulders, roots..); fish habitat & water quality
Aquatic Structures (mi)	3	Preserve	
Native Fish Reintroduction (mi)	4	Forest	Eliminate non-native fish and add native fish species
Invasive Plant Control (ac)	1,480	Forest	Reduce invasive plants using various methods; 90% in riparian areas
Invasive Plant Control (ac)	20	Preserve	
Road and Trail Work (mi)	400	Forest	Mostly road and trail decommissioning, rehabilitation, closures. Improve drainage and runoff
Road and Trail Work (mi)	1,200	Preserve	
Water Tank Work (#)	29	Forest	Eliminate, repair, replace, or install new water tanks to improve water quality, riparian, and wildlife habitat
Water Tank Work (#)	65	Preserve	

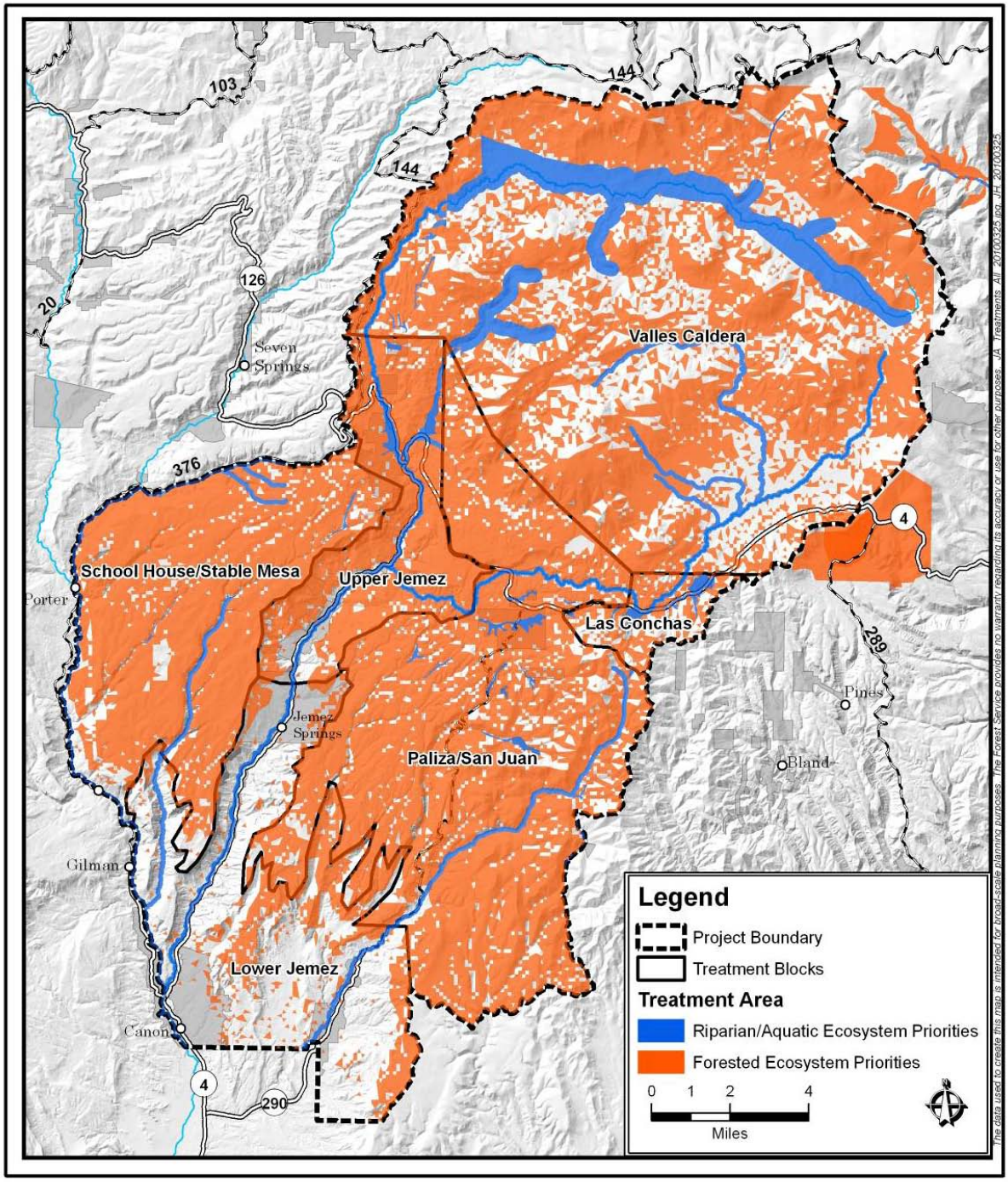


Figure 12.16. Proposed Treatment Areas and Blocks in the SWJM Restoration Strategy

Other Actions Common to All Treatments in this Strategy

The following actions listed by collaborators are common to all treatments in this strategy:

- Enforce laws, policies, and rules to improve restoration success, including the travel management rule that prohibits driving off designated routes
- Complete initial baseline monitoring, and continue with annual resource inventories, monitoring, and database updates for at least 15 years after implementation
- Improve workforce capacity within and outside agencies, including utilization of a broad public workforce consisting of volunteer groups, youth groups, college students, permit-holders, outdoor recreation clubs, local communities, and the general public
- Include public education and public relations focused on restoration objectives
- Design treatments to improve carbon sequestration and adaptations to climate change
- Plan for on-going maintenance, such as through using prescribed burns and management of naturally-ignitions, and invasive plant control treatments
- Follow guidelines in the NM Forest Restoration Principles, management direction in the Forest Plan, along with other policies and regulations aimed at conserving wildlife habitat, water quality, soil quality, heritage resources, and other resources that may be affected by treatment actions

Complementary Treatments

Similar forest and watershed restoration treatments are being planned to occur over the next 10-20 years on many of the neighboring forest lands, which will further support the success of this landscape restoration strategy. These include projects that involve stewardship contracts to improve forest and watershed health. They include additional treatments on land to the north and east being planned by Los Alamos County, LANL, Bandelier, Santa Clara Pueblo, treatments on NFS lands along the north and west sides, and treatments on Jemez Pueblo along the southern boundary.

Restoration actions have been initiated and on-going within the SWJM area over the past 10 years. They are smaller-scale projects with a more singular emphasis on hazardous fuel reduction, wildlife habitat restoration, or riparian restoration, rather than strategically planned pieces of a holistic, multi-resource, “all lands”, landscape restoration strategy. These recently completed or on-going projects include but are not limited to:

- CFRP projects listed in the Collaboration section
- Fuel reduction treatments around at-risk communities in the area such as the Thompson Ridge and Sierra de los Pinos subdivisions
- Aquatic/riparian restoration projects as part of Respect the Rio and EPA-319 grant programs, including public education programs

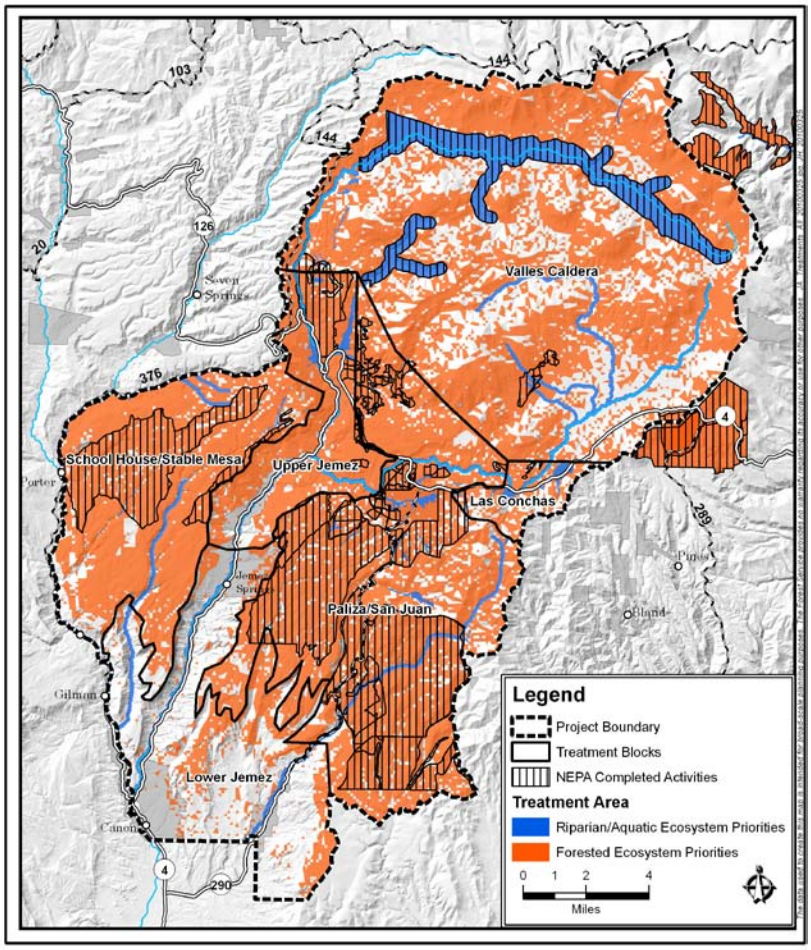
- Fire risk abatement projects completed on over 50 private properties in the area through USA Firewise, State Forestry and other programs conducted with willing landowners
- Wildlife habitat improvement projects through the Habitat Stamp Program
- Grazing allotment management plan NEPA completion and implementation of range improvements for all allotments that overlap this restoration strategy
- Past burning conducted on San Juan, Stable, and San Diego Mesas
- East Fork Jemez Wild and Scenic River riparian restoration including limiting livestock grazing, driving and camping in the riparian corridor

Implementation Readiness

This SWJM restoration strategy is substantially complete. The collaborative partnerships and consensus among divergent interest groups created a broad coalition of support for successfully implementing this strategy. Demonstration CFRP projects have been successfully planned and implemented in this SWJM area, and continue to provide important research publications and lessons-learned about forest restoration.

Implementation of several activities in this restoration strategy may begin immediately, as the planning, field-preparations and contracting work has been completed. Many prescribed fire treatments will be prepared in the summer of 2010 and implemented in the fall months. Some thinning contracts/agreements are in place as well for implementing right away. Out-year thinning work (for 2012 and later) will primarily be done through one or more stewardship contracts, which will be prepared in calendar year 2010. Some existing contracts and partnership agreements, including work under CFRP, RERI and 319 grants will continue to be used to implement this strategy, and new grants will likely be awarded to partners each year to assist with implementing and monitoring this strategy. Many treatment actions, particularly riparian treatments will be implemented through a variety of contracts, grants, and cost-sharing agreements among our numerous partners. Many non-federal partners will use volunteer crews for implementation, field preparation, inventory and monitoring. Burning will be done primarily by federal agency personnel. This strategy will provide training and employment opportunities to public and private entities, including under-represented minority groups, and youth groups including school students, scout troops, Youth Conservation Corps, student conservation association, Pueblo youth groups, and others. Additional assistance will come from hunting/fishing clubs, local property owners, scientific research institutions and universities, and others. Refer to Collaboration, Funding Plans, and Investments sections of the Proposal for more implementation and partnership details. See Monitoring and Adaptive Management Framework section for details on monitoring.

National Environmental Policy Act (NEPA) analysis and decision documents have been completed that cover approximately 9,900 acres of thinning/burning and 26,000 acres of prescribed burning treatments proposed in this SWJM strategy on Forest lands (Fig. 12.17). Those NEPA documents cover the first 1 to 3 years of proposed treatments on the Forest land, as well as the first 1 to 3 years of treatments on Preserve land. The NEPA decision documents are also complete for proposed activities on Bandelier and Santa Clara Pueblo lands. The following map (Fig. 12.17) shows the existing NEPA-coverage of proposed treatments in this strategy (as of February 28, 2010). A few NEPA documents are currently undergoing interdisciplinary team review to ensure that they still address current environmental conditions and proposed treatment activities.



The Regional Office is committing funds to support a dedicated NEPA Team whose priority will be landscape-scale forest and watershed restoration in New Mexico. This Team, in partnership with Forest personnel, will be responsible for completing the remaining NEPA decisions necessary to implement out-year treatments. By the end of 2010, the NEPA decision will be done for the invasive plant control treatments, and for the remaining treatments to be implemented within the first 3 years. In 2011, NEPA decisions will be complete on remaining treatments proposed for 2013-2014. The NEPA decisions needed for treatments in 2015-2019 will be completed at least 1 to 2 years ahead of the implementation schedule (Tables 12.7-12.8). Many of the proposed treatments can be categorically excluded from documentation in an EA or EIS, and others are expected to require an EA rather than an EIS, based on similar past restoration projects conducted on the Forest. The partners involved in developing this consensus-based strategy are confident that the NEPA analysis and decisions can be completed in a time and cost-efficient manner. The restoration treatment decisions are unlikely to be appealed or litigated, due to the strength of the on-going collaborative process, and use of guidelines from the collaboratively-developed New Mexico Forest Restoration Principles.

Inventories completed in this area are sufficient to implement the first several years of treatments, and will remain consistently ahead of the implementation schedule. The stand exams have been completed in the SWJM area, and most of the area has been surveyed for archaeological resources. Additional surveys are on-going and planned to be completed well in advance of the implementation schedule. Mandatory wildlife surveys have occurred throughout this landscape, and additional surveys on-going as needed to meet species-specific protocols. Baseline monitoring data is also being collected in advance of implementation.

The Forest, Preserve and partners involved in this strategy do not expect to add new permanent positions to their existing organizations in order to implement and monitor this strategy. Additional temporary help will be hired through contracts, interagency agreements, enterprise

team work orders, or other instruments. Cost savings will be realized by sharing resources, field crews and some databases between the Forest, Preserve and other partners; not filling new permanent positions and paying TOS costs; reducing wildfire suppression and rehabilitation costs, covering a large landscape area to reduce fixed costs per acre; and increasing workforce capacity to implement restoration treatments.

The monitoring and adaptive management framework for this SWJM strategy will be one of the most comprehensive, well-funded and scientifically-supported forest landscape restoration monitoring programs in the U.S. It is a multi-party plan, funded in part by a variety of partners and grants. It is built on an established multi-party monitoring program that includes 50 permanent monitoring sites, five climate stations (including a NOAA station that is part of a global climate change monitoring network), two carbon flux towers, a series of riparian exclosures, and a system of water quality and quantity instrumentation. It is being led by Dr. Parmenter, Chief Scientist on the Preserve. This adaptive management plan already involves over 40 different organizations and researcher scientists committed to its successful implementation. Using state-of-the-art approaches, restoration partners will measure and evaluate the extent and rate to which restoration treatments are reducing the risk of uncharacteristic wildfire and restoring natural fire regimes, reducing invasive species, improving wildlife and fish habitat, restoring water quality and watershed functions, maintaining or promoting old growth conditions, mitigating climate change impacts, and utilizing woody by-products. Monitoring will continue for at least 15 years after project implementation commences. Partners will prepare and review monitoring and evaluation reports, to develop adaptations and publish peer-reviewed literature on lessons learned. The strong established partnership between research scientists and land managers will continue to facilitate the success of implementing and monitoring this strategy in the Jemez Mountains. Refer to the Monitoring and Adaptive Management section of the Proposal.

If this proposal is selected for CFLRP funding, a more detailed implementation plan will be collaboratively developed and annually updated.

Annual Reports associated with implementing and monitoring this strategy will be produced in accordance with requirements described in the Title IV-Forest Landscape Restoration Act. These reports will include descriptions of performance in terms of acres treated and restored, community and ecological benefits, monitoring and evaluation results, and implementation and fire management costs.

Expected Outcomes

The treatments proposed for this landscape restoration strategy are expected to move all ecosystems in this contiguous landscape toward more resilient conditions so they will have the adaptive capacity to recover from endemic insect and disease outbreaks, wildfires and climate change events. Woody by-products will be an expected and important by-product to result from the thinning treatments. Most importantly, the restoration treatments will restore natural fire regimes and reduce the risk of uncharacteristic wildfires to occur that would otherwise seriously damage water, soil, fish, wildlife, scenery, heritage resources, recreation opportunities, tourism, forest/timber resources, and other values in this area.

Forest Ecosystems

Thinning and burning treatments play a critical role in addressing a multitude of ecosystem restoration needs identified for this landscape. These treatments are expected to: reduce the over-abundance of mid-sized closed-canopy forest that dominates the landscape; increase the amount of mature and old growth forest characteristics including the relative amount of large trees, snags and downed logs; increase the abundance and diversity of herbaceous vegetation on the forest floor; increase regeneration of ponderosa pine seedlings and aspen; increase the relative abundance of thick-barked fire-resistant tree species; reestablish or expand historic meadow and grassland ecosystems; improve wildlife habitat quality and diversity for all native species; reduce soil erosion and increase soil productivity. Thinning and burning to achieve these conditions will result in increasing biological diversity and species richness for flora and fauna in the area.

Thus, combinations and strategically located and prioritized treatment activities will have synergistic results in restoring resiliency to the various forested ecosystems on this landscape. The restored landscape will be significantly more diverse, dominated by a mosaic of different forest age-classes and densities. The ponderosa pine, dry mixed conifer and piñon-juniper forest types will be dominated by large fire-adapted species, variable-size canopy openings, and an understory of herbaceous vegetation. Reducing conifer density in all ecosystems will improve water quality and availability, and restore habitat for many TES species. Patches of young aspen will emerge from mid-elevation forests, and the landscape will show a greater dominance of large trees, downed logs and snags. The higher elevation spruce-fir forests will retain greater tree densities although treatments will improve structural complexity such that those ecosystems can recover from naturally less frequent, mixed-intensity fires. The structurally, compositionally, and biologically diverse landscape will support much more productive soils, natural hydrologic regimes, and a richer array of native flora and fauna, Fire will be allowed to play its natural and beneficial role in sustaining ecosystem resiliency. The restored landscape will have a significantly reduced risk of experiencing a large high-severity wildfire, thereby providing the best protection against damage to natural resources and human communities.

Wildlife

Treatments are designed to improve terrestrial wildlife habitat for a wide variety of native species. Removing conifers and restoring historic meadows and grasslands, and increasing forest openings filled with herbaceous vegetation will greatly improve foraging habitat for northern goshawk, Mexican spotted owl, peregrine falcon, and other TES species, as well as for deer, elk, bear, small mammals and many bird species. The thinning and burning treatments will significantly reduce the risk of losing forested habitat in a stand-replacing fire, while increasing foraging habitat. These treatments will increase structural diversity and promote mature and old growth forest conditions currently lacking on this landscape. Treatments provide opportunities to improve habitat quality within portions of 15,000 acres of suitable spotted owl habitat and 2,100 acres of protected activity centers; over 60,000 acres of potential northern goshawk habitat and 5900 acres of goshawk nesting/post-fledgling areas, and 26,000 acres of peregrine falcon nesting and foraging zones. Treatments will regenerate aspen in scattered areas within approximately 7000 acres of aspen/mixed conifer forests. Treatments will maintain or improve habitat for Jemez Mountain salamander in selected locations within approximately 18,000 acres of occupied or potential habitat, such as by increasing the amount of downed logs and reducing the risk of stand-replacing fires. Throughout the landscape, treatments will increase the relative

abundance of large trees, snags and downed logs, which will benefit many different species. Increasing the proportion of open canopied forest, understory plants, aspen, and old growth structures are all important habitat components that are currently deficit in relation to reference conditions. Treatments in TES species habitat will be designed in close coordination with US Fish and Wildlife Service and NM Game and Fish, and will follow the applicable TES species recovery or conservation plans, along with forest plan standards and guidelines.

Riparian and Aquatic Ecosystems

Riparian treatments such as eliminating invasive non-native plants and conifers; planting native riparian plants; revegetating barren areas; installing riparian exclosure fences; restoring functional water sources away from riparian areas; stabilizing streambanks; eliminating unneeded roads/trails; and using education materials and programs, are cumulatively expected to substantially improve riparian and wet meadow resilience and habitat diversity for many species, including New Mexico meadow jumping mouse, northern leopard frog, beavers, and many riparian-dependent birds and small mammals. The combination of riparian and aquatic ecosystem treatments will improve habitat for sensitive fish species such as Rio Grande chub and Rio Grande sucker that occupy over half the streams in the area, and will improve potential Rio Grande cutthroat trout habitat in 28 miles of streams.

In addition to improving fisheries habitat, riparian restoration activities will allow these sensitive riparian ecosystems to adapt to endemic pests, frequent wildfires, and climate change impacts. The treatments will improve water quality and reduce soil erosion and fine sediment in streams; improve stream channel morphology and increase stream meandering; promote formation of deeper pools; improve fish migration and breeding habitat; increase aquatic habitat complexity; reestablish or increase the abundance of native fish species, beavers, amphibians, riparian birds and small rodents; reduce invasive, non-native or exotic aquatic species; and limit future impacts from recreation uses, roads, and livestock grazing.

Water Quality and Watersheds

Water quality and watershed function will be greatly improved by proposed treatments. Water quality and watershed conditions will be less susceptible to a large, high-intensity fire causing severe floods and mass movement of soil and ash into stream channels. Water quality and hydrologic functions will also be improved by removing invasive plants and increasing native plant communities; creating forest openings that allow precipitation to infiltrate into the soil; increasing ground vegetation that reduces soil erosion and stream sedimentation while increasing soil productivity; eliminating primitive roads/trails along streams; stabilizing streambanks; revegetating denuded soils; and reducing camping, parking, driving, and cattle grazing along streams.

Invasive Plants

Invasive plant species management actions, including both prevention and control methods, are expected to: reduce the further spread of invasive and exotic plants; improve the abundance and diversity of native plant communities; restore moisture regimes and water availability in historically wet areas; and improve fish and wildlife habitat quality and species richness, including improving potential habitat for TES species such as the New Mexico meadow jumping mouse, northern leopard frog, southwest willow flycatcher, beavers, and other riparian species.

These treatments will be most evident in lower elevation riparian areas where concentrated populations of invasive species occur.

Roads and Trails

Road and trail treatments will provide many of the same benefits previously listed, as they are expected to reduce road density and other road-related impacts to wildlife species and habitat; soil, water quality, and watershed functions; heritage resources, scenic values, and non-motorized recreation opportunities. These treatments will also discourage illegal motor vehicle use off designated routes; reduce the introduction and spread of invasive plant species, and contribute significantly to meeting the stated restoration goal and objectives, particularly in riparian, aquatic, meadow, and grassland ecosystems. Improving the existing designated road system will reduce resource impacts while facilitating the removal of wood products.

Wildfires

Wildfire behavior throughout this landscape is expected to be substantially altered by the combination of proposed treatments in this strategy, which is one the main objectives of the strategy. Scientists from the USFS-Fire Sciences Lab and other interagency professionals analyzed potential fire behavior on this landscape using Landfire, FlamMap, and other modeling tools (see Scientific Methods). The FlamMap analysis showed approximately 77,000 acres (37%) of the SWJM area is susceptible to crown fire behavior (active or passive) under severe fire weather (95th percentile). Fuel inventory data and observations of past fires in the area suggest an even greater proportion of this landscape supports crown fire behavior under those conditions. The PROBACRE computer modeling tool indicated a 65% chance of a very large fire (over 4000 acres) in this area within the next 20 years. The FRCC analysis and map show approximately 60% of the Forest land in the area is dominated by ponderosa pine, dry mixed conifer and piñon-juniper ecosystems in fire regime condition class (FRCC) 3, which is highly departed from historic conditions and appears likely to support crown fire spread. Another 38% of the area is in FRCC 2-moderately departed. On the Preserve land, 15% of the acres in FRCC 3 and 75% of the acres on the Preserve are in FRCC 2. The moist meadows and wetlands in the Preserve are resistant to fire spread. Modeling fire spread in the SWJM area indicates that within just 6 hours a crown fire can be expected to consume 900-3,000 acres with rates of spread between 2-4 miles per hour (or up to 12,000 acres per day). The Cerro Grande (2000) fire burned in similar forest conditions on adjacent lands, consuming 45,000 acres and devastating the city of Los Alamos.

The risk of uncharacteristic wildfire will be substantially reduced, especially in the ponderosa pine and dry mixed conifer forests, through the combination of thinning and use of prescribed fire. Natural fire regimes will be reestablished with repeated prescribed burns using historical fire return intervals as a guide to determine appropriate frequencies. In areas where forest density, fuel arrangement, or tree size compromises prescribed fire effectiveness or safety, mechanical treatment will be done prior to burning. Eventually, conditions in the pine and dry mixed conifer forests should support more frequent fires that are mostly surface fires. Wildfire behavior in the restored landscape can be expected to mimic pre-suppression era (pre-1900) fire behavior, when fires in ponderosa pine forest burned about 1 to 2 times per decade. Wildfires would be expected to continue to burn with a wide range of intensities and rates of spread depending on fuel type and topography. Wildfire behavior in the mixed conifer/aspen type will be predominately surface fire with varied intensities and rates of spread with patchy torching.

Wildfires in the higher elevation spruce and fir forests in the Preserve can be expected to continue to burn less frequently and at higher intensities, adding to the patchiness and diversity of forest structure and species composition across the landscape. A restored landscape will provide more opportunity to manage unplanned ignitions other than with full suppression, consistent with the Forest's Fire Management Plan and other policies, guided by the Wildfire Decision Support System (WFDDS). Full suppression may still occur if the fire begins under conditions where private property is at risk or public safety is compromised. However, unplanned ignitions will gradually be used more as a tool for maintaining restored forest and meadow ecosystems in this area.

In developing this landscape strategy, the collaborators reviewed and used the Sandoval County Community Wildfire Protection Plan (CWPP), especially to identify the Wildland Urban Interface (WUI) and communities at highest risk to wildfire. The CWPP was used to help prioritize and strategically locate thinning and burning treatments to help protect at-risk communities identified in the CWPP. The CWPP shows that about 75% of the Forest land within the SWJM landscape is in a WUI, due to the numerous at-risk communities, public infrastructure (facilities), and domestic water sources in that portion of the landscape. The CWPP identifies the communities in the area as "high" risk because they are intermixed with overly dense forests. The collaborators also considered information in CWPPs covering adjacent lands: Greater Cuba Area CWPP, Los Alamos County CWPP, and Santa Clara Pueblo CWPP. The Los Alamos CWPP and Santa Clara Pueblo CWPP were used to extend and prioritize treatments on Bandelier and Pueblo land, as part of this SWJM strategy. The adjoining Bandelier, Pueblo and LANL lands to the northeast are highly vulnerable to crown fire spread from NFS land in this area due to the prevailing wind direction, topography, and forest conditions. Overall, the strategy was designed to be consistent with the goals, objectives, and priorities laid out in the applicable CWPPs.

A large restored landscape that is at or moving toward a natural fire regime condition class (FRCC 1) will be more resilient to wildfire. Most fires in the restored landscape will burn as surface fires that are easier to control than crown fires. There will be many fuelbreaks throughout the landscape and conditions should support natural fire regimes. This should significantly reduce the cost of wildfire suppression, burned-area rehabilitation, and other direct and indirect costs.

Where hazardous fuels have been reduced, lightning-caused wildfires can be managed rather than fully suppressed, which reduces management costs compared to fully suppressing those wildfires (Snider et al 2006). Suppression costs for the Forest for the past 20 years averaged $911 per acre, while the cost for the managing natural (unplanned) fire ignitions on the Forest averaged $372 per acre (for responses other than full suppression). Thus, managing lightning-caused fires rather than suppressing them could save an average of $539 per acre, while benefiting forest and watershed resources. As proposed treatments restore more of this landscape, more lightning-caused ignitions can be managed as prescribed fires rather than fully suppressed.

Another cost savings is associated with reduced post-fire rehabilitation costs. As the area is restored and the threat of stand-replacing fire is reduced, the costs associated with post-fire rehabilitation will also be reduced. An economic cost analysis conducted for this SWJM landscape using a Quicksilver program calculated potential present net value change in rehabilitation and fire damage costs for high value areas at $929 per acre.

The true cost of wildfires in the western U.S. is typically 2 to 30 times greater than just the suppression costs (Western Forest Leadership Coalition 2010). The Cerro Grande fire that burned in similar forest conditions on adjacent lands cost $33.5 million in direct suppression cost, $864.5 million in other direct costs, $72.4 million in immediate rehabilitation costs, and an additional $341 million in costs to repair LANL and Dept. of Energy facilities and equipment. Thus, suppression cost was less than 3% of the over $1 billion in total costs (Western Forest Leadership Coalition 2010). The "other direct costs" incurred during or immediately following the fire include costs for private property losses, damage to utility lines and recreation facilities, and aid to evacuated residents. Additional long-term or indirect costs that are not accounted for in most wildfire cost analyses include long-term water quality degradation, loss of timber value, declines in residential property values and business revenues, smoke impacts and related healthcare costs, highway shutdowns, loss of revenues to evacuated residents and businesses, loss of a host of ecosystem services-- aesthetic and scenic beauty, wildlife existence value, and others, and the cost of firefighter injury and death.

Wood Utilization

Another expected outcome of the strategy is the utilization of wood by-products from the proposed thinning treatments. The wood utilization workgroup evaluated the demand for small diameter wood products, along with the existing infrastructure and capacity, and potential for new markets that could utilize small diameter wood products. They began with a 2009 analysis of wood volume potential from forest restoration activities within each 6th-level watershed on the Forest and Preserve. They further analyzed potential wood utilization opportunities from the SWJM area, using a combination of stand exam and GIS data. Additional information on wood utilization potential was gathered from surrounding forests, and through reaching out to existing and potential wood product industry representatives in the region.

The total harvestable acreage and volume anticipated to be available from the forested NFS land proposed for treatment in the SWJM landscape is approximately 62,000 acres, or an average of 6,200 acres annually over the 10 year strategy period. Additional potential harvest acreage is expected to be available on adjacent forest lands during and after that 10-year period, including the rest of the Jemez District, and the Cuba, Coyote, Espanola Districts of the Santa Fe National Forest, along with other portions of the Forest and two other neighboring national forests. Harvestable acreage was calculated to include forested slopes with less than 40% grade, within the prioritized forest restoration treatment areas shown in Figure 12.16, which are mostly those in fire regime condition classes 2-3 (moderately or highly altered).

The table below shows the estimated harvestable acres and associated wood volumes on NFS land in the SWJM area, as well as estimates from surrounding lands on the Santa Fe and Cibola National Forests, within the next 10 years. Both Forests are in central New Mexico, within easy access of Interstate Highways I-25 and I-40, and in close proximity to the State's largest population centers.

Forest road networks are extensive throughout the proposed treatment areas on this landscape, and readily connect to state and interstate highways. No new permanent roads will be constructed. Some roads will be improved in order to facilitate conducting wood removal activities.

Table 12.5: Total 10-Year Harvest Acreage and Volume Available in SWJM Area and Adjacent National Forest Land on the Santa Fe and Cibola National Forests

NFS Forest	Acres	Volume (ccf)
SWJM Landscape Area- NFS land *(Forest, Preserve)*	62,000 *(53,030, 8,880)*	527,000 *(450,755, 75,480)*
Other Santa Fe National Forest areas	7,000	59,500
Cibola National Forest – all Districts	32,800	190,000
Total over 10 years	102,800	776,500

Based on average 8.5 ccf/acre for utilizing all 5-inch and larger diameter material for Forest-Preserve

Treatment cost for contracted thinning, wood removal, and slash preparation services in SWJM area is estimated to average $620 per acre, excluding slash burning (average $130 per acre). Total 10-year cost for contracted thinning with removal services will be approximately $38 million. This includes all direct costs for contracts, including contract preparation and administration. These costs will be offset by the price contractors will pay for the value of the harvested material, which is uncertain at this time and varies widely among different wood processors. The total offset based on forest product value is estimated to be $2.5 million (7% offset), based on Forest Service standard minimum rates and prices paid recently paid by thinning contractors in the area. Higher value products and greater offsets will be realized if new businesses decide to locate in the SWJM area.

Processing and distributing the material is one part of industry's role, along with the initial harvest and transport of raw material to processing facilities. The New Mexico Forest Workers Safety Certification (FWSC) Training Program indicates that there are over 400 workers in the state that are certified to conduct the harvest activities, with 113 of those within the SWJM production area. Existing harvesters/haulers in the local area include Velasquez, Conley, Cordova, Barela, Restoration Solutions, Western Wood Products, Chimayo Conservation Corps, Rocky Mountain Conservation Corps, Jemez Pueblo, Santa Clara Pueblo, HR Vigil, Mt. Taylor Pellets, and many others. This provides an indication of existing capacity to conduct harvest activities (http://www.forestguild.org/workers_comp.html). However, industry will likely respond to the significant increase in wood supply in central New Mexico by hiring and training additional employees.

Hauling costs for small diameter wood products is an important consideration. Past experience demonstrates that material from the Jemez Mountains can be efficiently transported to cities within about a 120 mile radius, including Albuquerque, Española, Raton, Grants, Taos, Las Vegas and others. Mt. Taylor Millwork for example is currently getting material from as far away as El

Paso and Reserve (with the BCAP program). As biomass markets continue to expand as anticipated over the next decade, distances could remain viable in the absence of BCAP funds. A thinning contractor in the Jemez Mountains (in Coyote, New Mexico) has recently hauled low value wood from forest restoration treatments to Taos and Las Vegas.

Considering the expressions of interest in the SWJM strategy and recent past thinning projects in the region, there appears to be sufficient existing infrastructure and capacity to handle the thinning operations and transportation of small diameter trees from this area. While there are no large-capacity lumber mills in the area, there are several smaller plants and a high potential to attract additional processing plants in the area. The Jemez Pueblo operates a forest restoration thinning crew and wood processing facility within this landscape area (Walotowa Woodlands Initiative), and the Santa Clara Pueblo also has a restoration thinning crew.

Several existing proprietor-owned businesses in and immediately around the SWJM area produce a variety of wood products, including specialty building materials (latillas, vigas and beams), specialty carvings for homes, wood chips, wood stove pellets, small furniture, and firewood. Approximately 23% of custom homes built in New Mexico include vigas (structurally or ornamentally), with each unit using an average of 255 lineal feet of vigas at a cost of $6.20 per lineal foot (Milakovsky and Irland 2009). Also, firewood is an important use of woody material in the region. It provides a cost savings in the form of reduced heating expenses, and an economic opportunity for entrepreneurs. Over 36% of houses in the Jemez Pueblo area are heated from wood (US Census 2000), and the Santa Fe National Forest sells thousands of personal-use firewood permits annually.

In 2009, the Regional Office published and mailed out a Sources Sought ad to solicit interest from forest products industries in New Mexico and gather information for the CFLRP proposals. Additionally, the SWJM collaborative group, including NM Forest Industry Association and Restoration Solutions are continuing to network with potential wood utilization businesses to gather more information and solicit interest. Expressions of interest in SWJM contracts have been received from businesses that would like to use the raw material expected to come from this restoration strategy. Some business owners were reluctant to complete surveys, and others completed the surveys but did not want their names or financial information (product values) disclosed. Wood utilization businesses we spoke with said supply is not keeping pace with the demand for their products; thus, they are seeking additional sources of raw material.

The SWJM restoration proposal has received a significant amount of interest from companies who want to conduct the forest thinning work and process the woody by-products. This provided further evidence of a willingness and ability of industry to expand infrastructure and capacity into the Jemez Mountains area based on the estimated increases in wood supply. This includes the following expressions of interest (records are available in the SWJM project file):

- Existing wood pellet companies in Arizona and New Mexico have expressed interest in obtaining wood from this project area, as have a couple of pallet-manufacturing companies. One company just purchased a second pellet mill to be installed in Albuquerque, to access wood from the Jemez Mountains area. These pellet and pallet facilities can utilize virtually all tree species and sizes of material.
- A company that produces posts and poles in Raton (employing 50 permanent employees) is interested in locating another plant in the Jemez Mountains area to utilize the material from this area; any tree species with a 4-inch minimum diameter top. They

would expect to employ an additional 20 to 35 permanent employees at the Jemez-area plant to debark and process the raw material prior to distribution.

- A viga and latilla processing mill in nearby Española is interested, along with a log home building company.
- A commercial firewood company in New Mexico that sells bundled and packaged firewood in the Albuquerque metro-area and other cities in the local area is interested in the raw material from this area, particularly the juniper and oak species.
- A family-owned business in Oregon expressed interest in the SWJM project. They conducted restoration and fuel reduction treatments on over 15,000 acres of forestland in seven western states and produced products with a total value of over $4,250,000. They are interested in 3 to 5 year contracts of several thousand acres each.
- Another Oregon-based company that expressed interest in the project currently employs over 150 people, has conducted 1200 forest restoration contracts on federal land in the U.S., and produces and sells a wide variety of wood by-products. They have the tools, equipment, crews, and capacity to utilize all the raw material from this area. To contract with the Forest and Preserve, they need a minimum of at least 1000 cords annually for firewood, 5000 ccf for pellets, and 1000 ccf of Douglas fir and ponderosa pine annually for lumber products (sawlogs, vigas, and others), in a minimum 3-year contract.
- Another Oregon-based company focused on the "preservation, protection and sustainability of our forests" is interested and well-equipped to do many types of restoration treatment operations. They have solid qualifications and experience in not only conducting many types of harvest operations, but also doing prescribed burning, road decommissioning and improvements, reforestation, invasive plant control (herbicide treatment), and other restoration activities proposed in this strategy. In thinning operations they use combinations of harvester-forwarder-loaders and masticators to reduce skid trails and landings (minimize soil disturbance).
- A company that produces a higher-value composite lumber product is interested in establish a processing plant in Grants, centrally located near the Santa Fe and Cibola National Forest on I-40, if they could obtain wood from 7,000 to 10,000 acres annually for at least the next 10 years. This company could utilize all of the wood volume projected in Table 12.5. They approached the Southwestern Regional Office in summer 2008 with interest in stewardship contracts from the four forests in north and central New Mexico. They sought investors and coordinated with Forest Supervisors, and Grants city and county officials to examine the nature of the investment, biomass potential, and degree of risk. They not only manufacture composite lumber but also utilize the bark and chips as landscape mulch. The value of their product could off-set the treatment costs by 100%.
- A restoration company from Texas, currently completing a forest restoration contract in Arizona, is interested in utilizing wood biomass from at least 5,000 acres annually over a 5 to 10 year period, while masticating the non-merchantable material as a soil amendment.
- Several local forest worker businesses are interested in bidding on the thinning operations.
- The New Mexico Forest Industry Association spoke with two existing mill owners interested in biomass from this project, including a local pellet-processing company and a venture group interested in locating in northern New Mexico.

- Companies that utilize wood biomass to create energy are also interested. A college in Santa Fe and schools in the Jemez Mountains developed the infrastructure and have used wood biomass from the Jemez Mountains to heat their facilities. There is a potential for a larger scale biomass facility to power local communities or the nuclear research facilities at Los Alamos National Laboratory (LANL), directly adjacent to SWJM area. In LANLs 2008 "Renewable Energy Feasibility Study" they evaluated three options for using wood biomass, requiring 30,000, 50,000 and 130,000 tons of biomass per year, from within a 100 mile radius (Jones and Arrowsmith 2008). If the laboratory decides to pursue biomass technology they could become key contributors to the SWJM strategy.
- A sustainable energy development company with plants in several western states including Arizona is interested in the SWJM strategy. This is a company of consultants who provide expertise to connect technology with commercial enterprises desiring to convert wood biomass into useful products for local markets, with intent to develop community employment and tax base. They have 100 full time employees, and train and hire local employees.

Table 12.6 displays the wood utilization and products that can reasonably be expected to be produced from this area, based on informal expressions of interest by local/regional industry representatives. Products not on this list are unlikely to be economically viable due to the cost of establishing new processing plants in the area, such as for reconstituted products like particleboard, fiberboard, veneer, plywood, and paper.

Table 12.6. Potential Wood Products from SWJM Area Currently Processed by Firms in FS Region-3 (New Mexico or Arizona)

Firewood, commercial use
Firewood, personal use
Biomass for energy: electricity and heat; wood stove pellets
Milled and preserved lumber, bolts, posts, poles, treated lumber, latillas, vigas
Wood containers and pallets, including wood boxes, flats, baskets, casks, crates
Engineered wood members, trusses, composite lumber materials
Prefabricated wood building materials
Mulch and bark for landscaping, animal bedding, erosion control, etc.

The Carson and Gila National Forests, located within 150 miles to the north and south of this area, could potentially add at least 10,000 acres for harvest over the next 10 years. In addition, there are three tribes with forest lands adjacent to the SWJM area who could add to the wood supply volume coming from this area over the next 10 years. Some received federal grants to conduct restoration treatments as well. There are several other tribes within 150 miles of the area that also are interested in thinning their forest lands.

Cumulatively, there is a high potential for providing economically viable wood utilization business opportunities in central and northern New Mexico. Existing wood products businesses declined in the past 20 years, partially due to lack of a steady and centralized wood supply and limited biomass utilization technologies. Retail demand for lumber in the U.S. is expected to increase 6.1% in 2010 and by 9.7% in 2011 (Western Wood Products Association 2010). The SWJM strategy provides an important opportunity to help meet public demand and improve economic trends in New Mexico by providing a reliable supply from a central, contiguously forested landscape, in additional to supplies from neighboring land. This type of supply situation has not occurred in New Mexico, so uncertainties remain. However, wood supply estimates in this proposal can help the industry consider new investment opportunities and business strategies. Based on the cumulative quantities of raw material to be made available from restoration projects in central New Mexico forests over the next 10 to 20 years, and the interest expressed by a variety of wood products businesses, it seems reasonable to assume that new wood products businesses will come to this Jemez Mountains area and utilize the woody byproducts from the SWJM project and surrounding lands.

Stewardship contracting will be the primary contract tool used for the thinning, wood removal and transport of raw material, and the contractor will also be required to lop-scatter, pile, masticate, or remove the slash (tree tops and limbs). While there are no guarantees that stewardship contracts will be awarded to local operators, there are several local wood utilization companies who have expressed interest in bidding on contracts to be offered from the SWJM area. Other types of contracts may be offered as well. The Omnibus Appropriations Act of 2009 (Sec. 413) provides Forest Service the authority in evaluating contract proposals for restoration projects to give consideration to local contractors who are from and provide employment and training for economically disadvantaged rural communities. The agency is also authorized to award contracts to local non-profit entities and other restoration partners.

Tree species to be harvested across the landscape, is estimated as: 45% ponderosa pine, 15 to 20% each of white fir and Douglas fir, and about 5% each of juniper, piñon pine, spruce, and aspen. Tree sizes will primarily be 10 to 16-inches in diameter (65%), with about 30% in 5 to 9-inch and 5% in trees over 16-inches in diameter. Trees greater than 16 inches in diameter are significantly lacking on this landscape in comparison with ecological reference conditions, with an overabundance of “pole-size” trees. Cutting prescriptions will be variable throughout this landscape, depending on site-specific conditions.

Even though SWJM restoration treatments are designed to meet ecosystem objectives rather than to maximize wood product outputs, there is a voluminous amount of wood that will be available to meet important social and economic needs. Utilizing excess wood from this area will reduce the amount of woody fuels that need to be burned, thereby reducing smoke production and prescribed burning costs. Proposed wood utilization from this landscape and surrounding land could significantly reduce treatment costs while supporting a wide variety of businesses, provide new jobs, and stimulate the economies of local rural communities in the Jemez Mountains area.

Other Socio-Economic Outcomes

This restoration strategy would have a variety of effects on the socioeconomic conditions of the local area. Both market and non-market benefits would be realized. Market benefits include the jobs and income that are supported by restoration activities. Non-market benefits include social

values stemming from improved ecosystem health and wildlife habitat, recreational values, and scenic values.

Creating sustainable employment opportunities is an important component of benefiting rural economies. The Forest Service developed the Treatments for Restoration Economic Analysis Tool (TREAT) to provide a standard interface for estimating employment (number of jobs) that would be generated from proposed CFLRP restoration proposals. The data underlying treat is IMPLAN 2007, an input-output model that reports economic data for every county in the United States. However, each TREAT model was tailored to each Forest Service region. According to the estimates, the SWJM restoration strategy would support 575.5 jobs and $22 million of labor income in Forest Service Region 3. TREAT averages the activities over the life of the strategy, therefore jobs are assumed to last for the 10 year period. However, if additional volume is harvested in the area it is likely that these jobs will continue beyond the 10 year strategy (see details about job creation in the Investments section of the Proposal).

Table 12.7 reports the total jobs and labor income that would occur within Region 3 as a result of the SWJM restoration strategy. The majority of jobs would be created in the commercial forest products sector. That includes all of the jobs required to get wood products from the forest to the marketplace. IMPLAN accounts for all of the supply chain events that would occur during that process, within Region 3 (New Mexico and Arizona). The 575.5 jobs are expected to last as long as restoration activities permit. Restoration activities outside of the SWJM area may contribute to sustaining these jobs beyond 10 years.

Table 12.7: Annual Jobs and Labor Income for the SWJM Restoration Strategy

	Jobs (Part and Full-time)	Labor Income (2009 $)
Commercial Forest Products	407.2	$15,794,877
Other Project Activities	135.5	$4,314,888
FS Implementation and Monitoring	32.8	$1,971,194
Total Project Impacts	575.5	$22,080,960

Source: TREAT, 2010

The jobs reported in Table 12.7 are a result of direct, indirect and induced effects. An increase in the level of harvesting in a region will likely result in logging companies hiring more labor to perform the additional work, migration of new logging companies to the area, or increases in wages paid by the companies. These impacts are referred to as “direct effects”. In addition to hiring more labor, industries must meet technical requirements by purchasing more equipment, supplies, and other inputs to production. Some of these purchases will be made from other local industries, such as fuel purchased by logging companies at local gas stations increases the output in the oil and gas industry. Those purchases would have an “indirect effect” on jobs and income in the oil and gas industry. An “induced effect” reflects changes in spending habits from individual households as income increases or decreases due to changes in production. For example, an increase in employment in the agriculture, forestry, fishing and hunting sector will be filled by unemployed individuals in the region and/or the in-migration of new households; and the increased income to those individuals will stimulate an increase in their demand for

goods and services in the local area, which in turn could cause firms to respond by increasing employment and output. Therefore the jobs reported in this section are a result of tracking the activities associated with the SWJM restoration strategy as it cycles through the complex economy of Region 3. Table 12.8 breaks down the total jobs by direct, and indirect and induced activity. In the case of commercial forest products, more jobs are created from the indirect activity than the activities directly associated with the restoration strategy.

Table 12.8: Detailed Employment Impacts

	Jobs (Part and Full-time)		
	Direct	**Indirect and Induced**	**Total**
Commercial Forest Products	201.3	205.9	407.2
Other Project Activities	99.1	36.3	135.5
FS Implementation and Monitoring	20.3	12.5	32.8
Total Project Impacts	320.8	254.7	575.5

Source: TREAT, 2010

A University of Oregon analysis of employment directly generated by forest restoration thinning contracts estimated the number of jobs to be 16 to 24 jobs per $1 million dollars spent. They included jobs for mechanized thinning, hauling, monitoring, and administering the contract (http://ewp.uoregon.edu/downloads/WP24.pdf). Another accounting of jobs directly generated by a $300,000 CFRP restoration contract in New Mexico reported an equivalent of 53 jobs per $1 million, although that contract involved more labor-intensive manual thinning crews, along with hauling, monitoring, and administering the contract (Forest Guild 2009).

In addition to increasing employment, the SWJM restoration strategy will also result in non-market values or social benefits that are difficult to quantify. Collaborators involved in developing the strategy discussed how improving the health and resilient forest ecosystems in this area will improve the health of small rural communities in the Jemez Mountains. They identified how the strategy would reduce the threat of losses to the community from a stand-replacing wildfire event, including potential loss of spiritual and recreational and scenic values. Restoration efforts and reduced risks of catastrophic fire would also help ensure that recreation and tourism-related expenditures and economic activity would continue for years to come. In the SWJM area, the recreation and tourism industry is critical to the local economy, and is supported by having healthy forest ecosystems. Healthier ecosystems will support recreation values for many local residents as well, many of whom can't afford to travel elsewhere for recreation. These opportunities support social values that contribute to community sustainability. Similarly, restoring healthy ecosystems will result in supporting the spiritual solace and traditional forest-based activities for many long time residents. Healthy ecosystems are vital to the continuation and enhancement of cultural values, as well as spiritual retreat and renewal.

The restoration strategy would improve conditions for wildlife, water quality, soil and native vegetation, providing many non-monetary ecosystem services benefits to society. The expected improvements in water quality and supply would yield benefits for agriculture, community

drinking water, and fire suppression. Restoration would also enhance scenic values of the landscape, which are known to affect property values and visitor experience.

Other Expected Outcomes - from Workshop Participants

Collaboration participants who attended the February 2010 workshop to develop the SWJM restoration strategy began the workshop by quickly, spontaneously answering this question about expected outcomes: *After implementing 10 years of restoration treatments in this area, what would you like to say has been accomplished?* These are the answers initially expressed by this group, which we believe are realistic expectations of this SWJM strategy:

- We're celebrating accomplishments related to resilience of forests and economies
- All interests continue to be represented, voices heard, and outcomes enhanced
- Ownership is passed to newcomers in each agency to carry-on this partnership
- Biomass jobs go to local communities (7000 acres per year, 10 new businesses)
- There is less difference in landscape conditions across administrative boundaries
- Native wildlife populations are restored; beaver and trout are in every stream
- This area is used as a restoration model, and work continues beyond 10 years
- Forests are more resilient, with better watersheds and water availability
- Benefits from resilient ecosystems and carbon sequestration are realized
- Ecosystems are functioning or moving closer to reference conditions
- Local communities are involved, particularly youth groups
- Collaborative process and social awareness are ongoing
- Public has a greater acceptance of fire use and smoke
- Adverse effects of climate change are mitigated
- Goals and objectives of the CFLRP are met
- Fires are used rather than suppressed
- Grazing regimes are addressed

Summaries of Treatments Identified and Prioritized

As previously mentioned, this SWJM strategy is substantially complete and the first few years of treatments are ready to be implemented if this project is selected for CFLRP funding. The following tables display estimates of the acres and miles for each treatment activity, which have been prioritized spatially (by locations) and temporally (by year). The first table displays the annual distribution of treatment acres and miles for the entire 10 year strategy period. The landscape size and strategically-developed treatments should allow for a high degree of effectiveness in meeting restoration objectives in a large, contiguous and unfragmented landscape within this CFLRP funding period. The amount of each activity may increase or decrease based on actual funding and staffing resources available.

Table 12.7. Annual Treatment Schedule and Quantities by Jurisdiction and Treatment Type

Jurisdiction	Treatment Type	Totals		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Forest	Thin, Remove, Burn (ac)	53029		300	4380	5500	5500	6200	6720	7700	6700	6710	6110
Preserve	Thin, Remove, Burn (ac)	8880		0	0	900	900	900	900	2500	2500	2500	0
Bandelier	Thin, Remove, Burn (ac)	310		110	0	90	110	0	0	0	0	0	0
JemPueblo	Thin, Remove, Burn (ac)	370		0	0	185	185	0	0	0	0	0	0
Forest	Thin, NoRemov, Burn (ac)	18080		800	600	2240	1240	1840	1840	1740	2700	2890	2190
Preserve	Thin, NoRemov, Burn (ac)	7504		0	600	730	730	730	730	1320	1320	1320	1900
SCPueblo	Thin, NoRemov, Burn (ac)	2230		550	560	560	560	0	0	0	0	0	0
Forest	Burn Only (ac)	27410		0	3200	3400	3700	3700	3300	3710	2700	1100	2600
Preserve	Burn Only (ac)	41500		160	230	3500	3500	3500	3500	7300	7300	7300	5370
Bandelier	Burn Only (ac)	3830		0	1260	0	1060	1510	0	0	0	0	0
JemPueblo	Burn Only (ac)	3400		0	0	1130	1130	1140	0	0	0	0	0
Forest	Riparian Rehab Actions (ac)	245		10	26	26	26	26	26	26	26	26	27

Jurisdiction	Treatment Type	Totals		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Preserve	Riparian Rehab Actions (ac)	55		0	5	5	5	5	5	5	5	10	10
SCPueblo	Riparian Rehab Actions (ac)	60		30	30	0	0	0	0	0	0	0	0
Forest	Riparian Exclosures (mi)	10		0	1	1	1	1	1	1	1	1	2
Preserve	Riparian Exclosures (mi)	5			1	1	1	1	1				
Forest	Aquatic Structures (mi)	24		0	2	2	3	3	3	3	3	3	2
Preserve	Aquatic Structures (mi)	3		0	1	1	1						
Forest	Fish Reintroduction (mi)	4		0	0	0	0	0	0	0	0	2	2
Forest	Invasive Plant Control (ac)	1480		0	100	150	150	250	150	200	200	110	170
Preserve	Invasive Plant Control (ac)	20		0	0	4	4	4	4	4	0	0	0
Forest	Road and Trail work (mi)	400		0	50	50	50	50	50	50	50	25	25
Preserve	Road and Trail work (mi)	1200		55	105	130	130	130	130	130	130	130	130
Forest	Water tank work (#)	29		1	2	3	4	4	4	3	3	3	3
Preserve	Water tank work (#)	65		0	6	6	7	7	7	8	8	8	8

The following table shows the details of the thinning and burning treatment locations to be implemented in specific prioritized locations. Locations of treatment blocks identified in this table are displayed on the previous treatment map, Figure 12.11.

Table 12.8. Prioritized Thinning and Burning Treatment Locations and Acres by Implementation Year

Fiscal Year	Jurisdiction	Treatment Block	Thin,Remove Wood, Burn (acres)	Thin, No Removal, Burn (acres)	Prescribed Fire Alone (acres)
2010	Bandelier	Area7 & FR289	110	0	0
2010	Forest	Paliza-SanJuan	300	800	0
2010	Preserve	CFRP	0	0	160
2010	SC Pueblo	SprucefirAcres	0	550	0
2011	Bandelier	Area7,ScooterPk	0	0	1260
2011	Forest	Paliza-SanJuan	4000	500	0
2011	Forest	Paliza-SanJuan	0	0	2410
2011	Forest	UpperJemez-VC	380	100	790
2011	Preserve	RedondoCyn	0	600	0
2011	Preserve	Scooter Pk	0	0	230
2011	SC Pueblo	SprucefirAcres	0	560	0
2012	Bandelier	ValleIIN Thin	90	0	0
2012	Forest	Paliza-SanJuan	5000	500	0
2012	Forest	Paliza-SanJuan	0	0	3400
2012	Forest	UpperJemez-VC	500	740	0
2012	Jem Pueblo	Paliza	370		

Fiscal Year	Jurisdiction	Treatment Block	Thin,Remove Wood, Burn (acres)	Thin, No Removal, Burn (acres)	Prescribed Fire Alone (acres)
2012	Jem Pueblo	Paliza	370		
2012	Jem Pueblo	Paliza	370		
2012	Preserve	PP, dry MC	900	730	3500
2012	SC Pueblo	SprucefirAcres	0	560	0
2013	Bandelier	ValleIIS & Area1	110	0	1060
2013	Forest	Paliza-SanJuan	4400	900	0
2013	Forest	Paliza-SanJuan			1400
2013	Forest	Schhse-Stable	3500	200	0
2013	Forest	Schhse-Stable	0	0	2300
2013	Forest	UpperJemez-VC	600	740	0
2013	Jem Pueblo	Paliza			1700
2013	Preserve	PP, dry MC	900	730	3500
2013	SC Pueblo	SprucefirAcres	0	560	0
2014	Bandelier	Area 9 Burn	0	0	1510
2014	Forest	Paliza/SanJuan	3500	900	0
2014	Forest	Paliza/SanJuan			2400
2014	Forest	Schhse-Stable	2700	200	0
2014	Forest	Schhse-Stable	0	0	1300
2014	Forest	UpperJemez-VC	0	740	0

Fiscal Year	Jurisdiction	Treatment Block	Thin,Remove Wood, Burn (acres)	Thin, No Removal, Burn (acres)	Prescribed Fire Alone (acres)
2014	Jem Pueblo	Paliza			1700
2014	Preserve	PP, dry MC	900	730	3500
2015	Forest	Paliza-SanJuan	1500	900	
2015	Forest	Schhse-Stable	2700	200	0
2015	Forest	Schhse-Stable			3300
2015	Forest	UpperJemez-VC	2520	740	0
2015	Preserve	PP, dry MC	900	730	3500
2016	Forest	Paliza-SanJuan	2500	800	0
2016	Forest	Schhse-Stable	2700	200	1100
2016	Forest	UpperJemez-VC	2500	740	2610
2016	Preserve	Wet MC, Aspen	2500	1320	7300
2017	Forest	Paliza-SanJuan	3800	2600	2700
2017	Forest	Schhse-Stable	2900	100	0
2017	Preserve	Wet MC, Aspen	2500	1320	7300
2018	Forest	Las Conchas	1200	700	0
2018	Forest	Lower Jemez	1510	1890	0
2018	Forest	Paliza-SanJuan	800	300	0
2018	Forest	Schhse-Stable	3200	0	1100
2018	Preserve	Wet MC, Aspen	2500	1320	7300

Fiscal Year	Jurisdiction	Treatment Block	Thin,Remove Wood, Burn (acres)	Thin, No Removal, Burn (acres)	Prescribed Fire Alone (acres)
2019	Forest	Las Conchas		0	2400
2019	Forest	Lower Jemez	1510	1890	200
2019	Forest	Paliza-SanJuan	800	0	
2019	Forest	Schhse-Stable	3800	0	0
2019	Preserve	Spruce,UpGrass	0	1900	5370