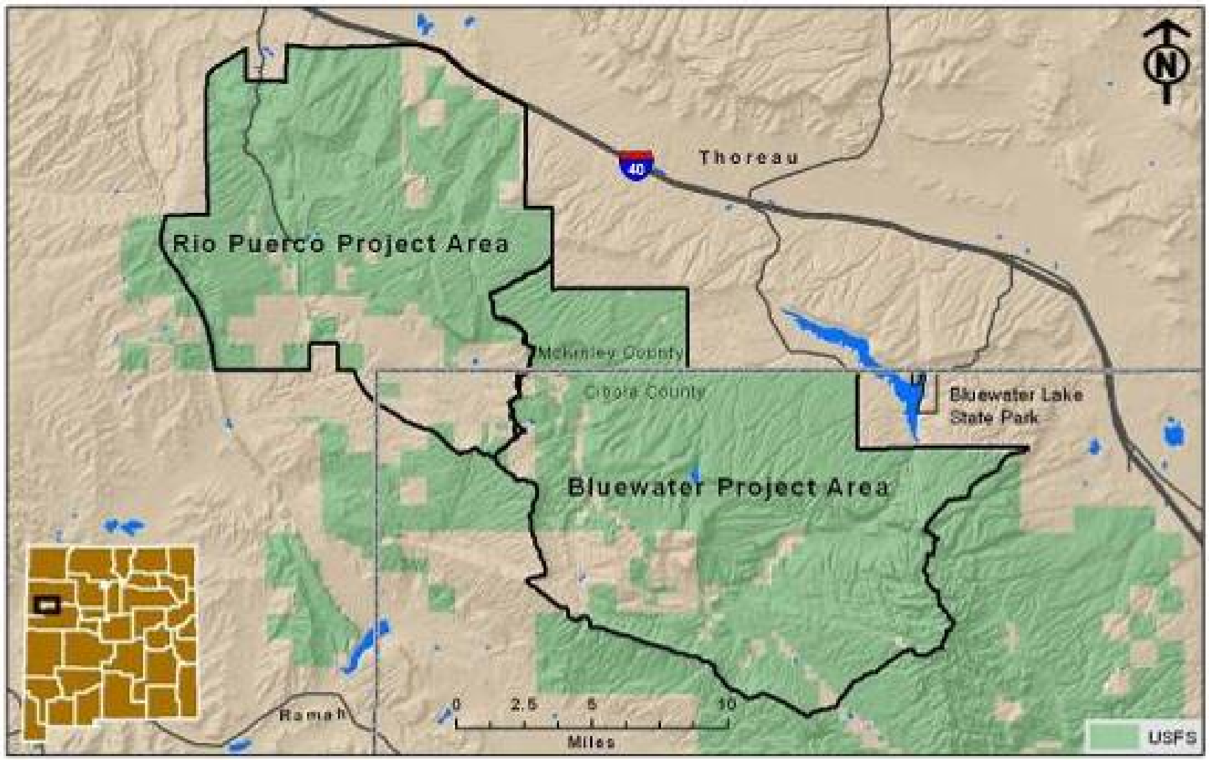
Zuni Mountain Landscape Strategy

Collaborative Forest Landscape Restoration Program: Proposal for Funding









CIBOLA NATIONAL FOREST

Executive Summary

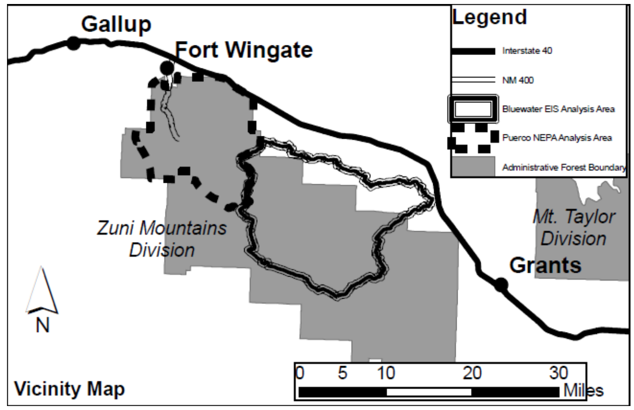
Embracing the USDA Forest Service mission to "sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations," the Zuni Mountain Landscape (ZML) strategy, rooted in the science of ecological restoration, will pursue a multipronged approach including:

- restoring forested ecosystem structure and processes,
    - protecting old and large trees
    - removing excess small trees
    - returning fire to the ecosystems at appropriate intervals
- stabilizing forest restoration-based businesses through a long term wood supply,
- improving hydrologic function,
    - reduced sublimation of snow fall
    - increased water infiltration
    - and attenuated snow melt driven runoff
- protection of the Zuni bluehead sucker (ZBS),
    - from post crown fire erosion events
    - reduce unauthorized use of roads near existing ZBS populations
    - establish vegetation conditions that may increase water availability
- sustaining a restoration workforce in Cibola and McKinley counties through increased forest work and available wood fiber,
- creating a culture of forest restoration across the landscape through the public involvement process,
- continuing education and outreach efforts with local non-profits and Youth Conservation Corps crews,
- determining effectiveness of the restoration effort by monitoring a broad array of ecological and socioeconomic indicators, and
- continuously improving management through an adaptive management process driven by the multiparty monitoring process.

Table of Contents

Area Overview

Situated in west-central New Mexico, the Zuni Mountain Landscape (ZML) is comprised of moderate terrain dominated by ponderosa pine and piñon-juniper ecosystems. This landscape is culturally important to several Native American Pueblos and Tribes including Laguna, Acoma, and Zuni Pueblos as well as the Navajo Nation and the Ramah Navajo Chapter. Since the late 19th century the landscape was critical to surrounding communities and their economic activity which utilized the forested landscape for timber, grazing, mining, and game. In fact, the ZML was heavily logged with the arrival of the railroad in the 1880s (Dick-Peddie 1993). Logging continued through the 1980s albeit at a lower intensity. With the decline of logging and mining in the area, rural communities of Cibola and McKinley counties lost their wood harvesting and processing infrastructure. The economic decline stemming from the loss of traditional forest-based industry has driven a cycle of poverty that ranks as one of the highest in the state (US Census Bureau 2010).



The ZML has two main planning areas that are ecologically similar. The Bluewater watershed makes up the eastern the eastern half and the Rio Puerco project area covers the western half. The Rio Puerco project encompasses forested areas of the South Fork Rio Puerco and Rio Nutria watersheds and to a lesser extent Defiance Draw-Upper Puerco River and Whitewater Arroyo watersheds. The Bluewater watershed drains to Bluewater Creek and the Puerco project area drains to the Rio Puerco to the north and the Rio Nutria to the south. The majority of both the Bluewater watershed and the Rio Puerco project area are managed by the USDA Forest Service, Cibola National Forest Mt. Taylor Ranger District with collaboration from many local stakeholders.

Collaboration

Collaboration for the ZML was born out of a need to make forests safer and create economic opportunity for rural-forest-based communities that had few alternatives. While the need for collaboration to achieve common goals was recognized well over a decade ago, the trust building, relationships, technical assistance, and teamwork took years to form. The following collaborative efforts helped shape the ZML strategy. What is not captured in the list below are the countless weekend meetings between stakeholders over coffee, the phone calls to discuss ideas, or the leaps of faith taken when someone reaches out for help when they no longer can do it alone.

In the past decade there have been steadily increasing forest restoration, collaboration, and wood utilization investments within and adjacent to the ZML. Beginning in 2001 there has been nine Collaborative Forest Restoration Program grants on District, Tribal, BLM, and State Land Office lands (Table 1). These grants have restored forest structure across a few thousand acres, established the Wood Industries Network (WIN), addressed wood utilization and marketing, and strengthened markets for restoration wood. In addition there have been two USDA Forest Service Forest Product Laboratory woody-biomass utilization grants and two New Mexico Association of Counties wildland-urban interface grants. On the Mt Taylor Ranger District, there is an active Stewardship Contract and a 10 year Stewardship Agreement. There have also been service contracts, American Recovery and Reinvestment Act funded restoration treatments, and Indefinite Delivery Indefinite Quantity (IDIQ) contracts, and riparian restoration in the Bluewater watershed. On private lands NM State Forestry and Soil and Water Conservation Districts have partnered to treat acres to reduce fire and insect outbreak risk.

Table 1. History of Projects or Events that Support Landscape Restoration

Year	Project or Event
2001	1. CFRP Project: Zuni Cibola Forest Restoration Initiative 2. CFRP Project: Pueblo of Acoma forest enhancement and piñon-juniper thinning and utilization
2002	1. CFRP Project: Developing Small Diameter Utilization and Stewardship Capacity in Navajo Communities
2003	1. Bluewater EIS Completed 2. CFRP Project: Restoring Our Sacred Forests, Ramah Band of Navajos
2004	1. CFRP Project: Zuni Healthy Forest & Watershed Initiative
2005	1. CFRP Project: Bluewater Wildland Urban Interface, Piñon Juniper Meadows Restoration Project 2. Establishment of Wood Industries Network (WIN)
2006	1. Cibola and McKinley Counties community wildfire protection plans completed
2007	1. Two Forest Product Laboratory biomass utilization grants
2008	1. Lobo Canyon wildland urban interface and FireWise project 2. CFRP Project: Ramah Navajo Forest Management and Forestry Energy Development Program
2009	1. National Wild Turkey Stewardship Agreement signed. 2. American Recovery and Reinvestment Act projects initiated in the Bluewater watershed. 3. CFRP Project: Capacity Building, Restoration, and Wood Utilization in the Bluewater Watershed 4. NM Statewide Forest Resources Assessment completed.
2010	1. CFRP Project: Increased Forest Restoration and Utilization in the Cibola 2. Bluewater Village wildland urban interface and FireWise project

There are many success stories from the past decade of forest restoration work including thousands of acres thinned in preparation for prescribed fire, thinning crews trained and safety certified, businesses retooled, biomass markets established, partnerships formed and tested, hand crews trained in mechanized harvesting, multiparty monitoring and adaptive management pursued, and the WIN was created. Established in 2005, WIN has been the forum for establishing restoration business partnerships, pursuing grants, contracts, and agreements across multiple land jurisdictions, and evaluating monitoring data and making management recommendations among other efforts.

All of these efforts within or in close proximity to the ZML have required broad support from diverse collaborators. Reflecting on the past decade, these forest restoration efforts, while often successful on many fronts, in hindsight were scattershot in their approach. This CFLRP marks a well planned, comprehensive to build on the strength of established collaboration. The following collaborative meetings were held in support of the ZML proposal:

- August, 2010: Initial CLFPR planning held with Cibola NF staff and Forest Guild
- September, 2010: Wood Industries Network endorse CFLRP proposal for Zuni Mountains
- November, 2010: Initial landscape strategy planning meeting
- January, 2011: Landscape strategy planning session[1]

Ecological Context

In Southwestern ponderosa pine ecosystems, high-intensity fires currently burn across larger areas than they did historically (Swetnam and Betancourt 1998, Westerling et al. 2006). A natural fire regime of predominately frequent, low-intensity surface fires were a part of the natural process that helped shape these ecosystems. Local fire history immediately adjacent to the project area and east of the Continental Divide indicates a pre-settlement fire return interval of every 5 years (Grissino-Mayer and Swetnam 1997). Like many forests in the west, the focus watersheds have become unnaturally dense since the late 1800's because of relatively recent land management practices that include logging, the disruption of natural fire regimes, and livestock grazing (Cooper 1960, Covington and Moore 1994, Lynch et al. 2000). The management of these uncharacteristically dense forests and their related fire hazard is one of the most important land stewardship issues in the western United States (Noss et al. 2006). Within the Zuni Mountain area, due to the fundamental shift in forest structure, fires are now at risk of burning at a severity, frequency, and scale that is outside of the historic range of variability. The focus watersheds have been identified as one of the highest priorities by the *New Mexico Statewide Natural Resources Assessment* (2010) because of the threat of wildfire and forest health problems.

The 2004 Sedgwick Fire, the most recent large crown fire in the ZML, resulted in the loss of a Mexican spotted owl (MSO) protected activity center (PAC). Despite the best efforts of local managers, more habitat losses could occur. The current conditions of the project area show that 60-70% of the project area is at risk for active crown fire potential, and 10-20% is at risk of passive crown fire potential; (ENMRD Forestry Division 2010). Approximately 70% of the Forest land in the area is dominated by ponderosa pine, dry mixed conifer, and piñon-juniper is in FRCC III, which is highly departed from historic conditions and appears likely to support crown fire spread. Another 20% is in FRCC II which represent moderately departed conditions (LANDFIRE 2010).

The focus watersheds also face increased pressure from a changing climate. On average, the climate in the region is likely to be warmer and drier by the end of the 21st century than it was

[1] On January 10, 2011 over 40 collaborators attended a one day proposal development meeting. The sign-in sheets can be accessed here, http://www.forestguild.org/CFLRP/Documents/01102011_SignInSheet.pdf.

during the 20th century with warmer spring and summer temperatures, reduced snowpack and earlier snowmelts, and longer, drier summer fire seasons (Westerling et al. 2006, IPCC 2007, Dominguez et al. 2010). Warming and drying conditions are likely to cause increased fire activity based on three lines of evidence (Westerling et al. 2006, Westerling and Bryant 2008). Other effects of a warmer, drier climate in the Southwest include reduced growth and increased mortality (Williams et al. 2010). A warming climate and altered precipitation regimes will cause other ecosystem changes such as increased success for bark beetles (Bentz et al. 2010). Forest restoration is a crucial way of fostering resistance and resilience to the impacts of climate change (Millar et al. 2007).

Forest restoration is the primary solution to the problem of increased fire risk caused by decades of fire suppression in fire-adapted forests (Allen et al. 2002). The risk of uncharacteristic fire will be reduced through a broad means of forest restoration to reduce hazardous fuels by thinning and prescribed fire. The use of prescribed fire will reestablish natural fire regimes by using historical fire return intervals as guidance within the project area. In areas where forest density, fuel arrangement, or tree size compromises prescribed fire effectiveness, mechanical treatments will be implemented prior to burning. Eventually, conditions in the pine and dry mixed conifer should support more frequent surface fires that were historic in the area. This will facilitate the use of prescribed fire and increased management of wildland fire to meet resource objectives for maintaining the natural fire regime.

In addition to the upland ecosystems previously described, the Puerco project area hosts significant aquatic habitat. The headwaters of the Rio Nutria and its tributaries are critical to the Zuni bluehead sucker (ZBS) (*Catostomus discobolus yarrowi*), which is listed as endangered in New Mexico under the authority of the New Mexico Wildlife Conservation Act of 1995. The *Zuni Bluehead Sucker Recovery Plan* (Carmen 2004) indicates that the current known distribution of the state endangered species are only found north of the Nutria Box in stretches of the Upper Nutria, Agua Remora, and Tampico Draw which occur almost exclusively on lands managed by the Mt. Taylor Ranger District and the Nature Conservancy. In partnership with New Mexico Department of Game and Fish, the Cibola National Forest began managing for the conservation of the ZBS in 1979 by fencing riparian areas and listing it as a sensitive Southwestern species in 1988. The recovery plan (Carmen 2004) indicates that erosion, grazing, road density, and widespread overstory removal negatively impact ZBS populations and habitat.

Socioeconomic Context

By the later half of the 20th century forest sales from US Forest Service land was about 300 million board feet per year, of which 80% was saw timber (Johnson 1994). Timber harvests from both public and private forests in Arizona and New Mexico peaked in about 1990 when roughly 433 million board feet per year were harvested (Covington 2003). After this peak, harvests declined dramatically due to limited availability of large trees, threatened and endangered species, appeals and litigation of federal timber sales, and federal budgets (Morgan et al. 2006). The Mexican spotted owl was listed as threatened in 1993, a Federal judge stopped new timber sales on National Forests in Arizona and New Mexico in 1995, and harvests on National forests in Arizona and New Mexico dropped from about 425 million board feet in 1990 to 48 million board feet in 1996 (Morgan et al. 2006). In 1996 the timber harvesting injunction was lifted and by 2002 about 74.4 million board feet was harvested in New Mexico providing nearly $48 million dollars in sales (Morgan et al. 2006). The “Timber Wars” of the 1980’s are often blamed for the demise of New Mexico’s timber economy, while in reality, the over-extractive nature of harvesting, weakened markets for dimensional lumber, and lack of diversity within the forest-based industry infrastructure were the main culprits. The timber wars and subsequent ban on timber sales in the 1990’s were just a few more holes in an already leaking bucket.

As highlighted in the recent *New Mexico Statewide Natural Resources Assessment* (2010), there are many other economic benefits to forest restoration including renewable energy, recreation, and clean water. New Mexico has significant potential for development of forest biomass as a renewable source of energy. However, use of forest biomass for energy has been limited by the difficulty in setting up wood-to-energy facilities, by inconsistent supply, and harvesting and transportation costs (Evans and Finkral 2009).

Millions of tourists come to New Mexico each year and in 2003, the 1.2 million people who came *specifically* to participate in outdoor recreation spent $160 million dollars and generated $288 million dollars in indirect spending (CRC & Associates 2007). In New Mexico, 787,000 people spent about $297 million dollars watching wildlife during 2006 (USFWS and US Census Bureau 2006), and the total economic impact of people who enjoy watching wildlife is as much as twice that value (La Rouche 2001). The total economic impact of hunting in New Mexico in 2001 was estimated at about $342 million dollars (IAFWA 2002). In the high deserts of New Mexico, water is particularly valuable because of its scarcity. In 2006, the Rio Grande Basin (the largest river system in the state) received 29 percent of its water from National Forest lands and an estimated 0.33 acre-feet per year of surface water flows originated from each acre of National Forest lands in New Mexico (Sedell et al. 2000, Berrens et al. 2006). At $17 per acre-foot the value of water calculated in 2000 just for in-stream flow (Sedell et al. 2000), New Mexico’s forests provide at least $93.7 million dollars in clean water.

While forests serve as a significant source of revenue to New Mexico, many of the communities in and around these forests do not share the wealth and are impoverished. For example, the focus watersheds are in one of the most economically disadvantaged areas of New Mexico. In the state as a whole about 14% of families are below the poverty line, however this CFLRP proposal focuses on McKinley and Cibola counties where 27% and 18% of families are below the poverty line (US Census Bureau 2010). In these two counties the per capita income was about $13,400, only 60% of the statewide average. In 2009, the unemployment rates for McKinley and Cibola counties were 8.7% and 18% respectively while statewide the unemployment rate was 6.8% (US Census Bureau 2010). Approximately 64% of the population in McKinley and Cibola countries is Native American while about 19% is Hispanic or Latino (US Census Bureau 2010). The area has a particularly low density of wood processors and distributors compared to other forested areas of the state (EMNRD Forestry Division 2010). The proposed CFLRP will provide new economic opportunities to a community in desperate need of jobs.

The current economic conditions of the ZML were also recently analyzed as part of the Mt. Taylor Ranger District Travel Management Environmental Assessment which in turn was part of the broader Travel Management Planning process across USDA Forest Service lands. Using the Headwaters Economics model the analysis found that although the populations within and surrounding the landscape are growing, they exhibit poor resilience to economic downturns.

The analysis also found that prior to the 1990s, extractive industries such as timber and in particular uranium mining were keystone elements of the local economies. Local businesses and county economic development offices note that active and passive recreation and visitation are currently very important to local economies and will be in the future (Russell and Adams-Russell 2005, UNM-BBER 2007). There are also two planned subdivisions in Forest Service in-holdings on private land in the ZML. Due to the 2008 recession, they are not fully built yet pose a serious risk to the ZBS as any reduction in surface water or shallow ground water will negatively affect the viability of the species.

Restoration Vision:
A landscape where the vegetation is resilient in the face of climate change, resistant to uncharacteristic crown fires, and supports healthy animal and human communities.

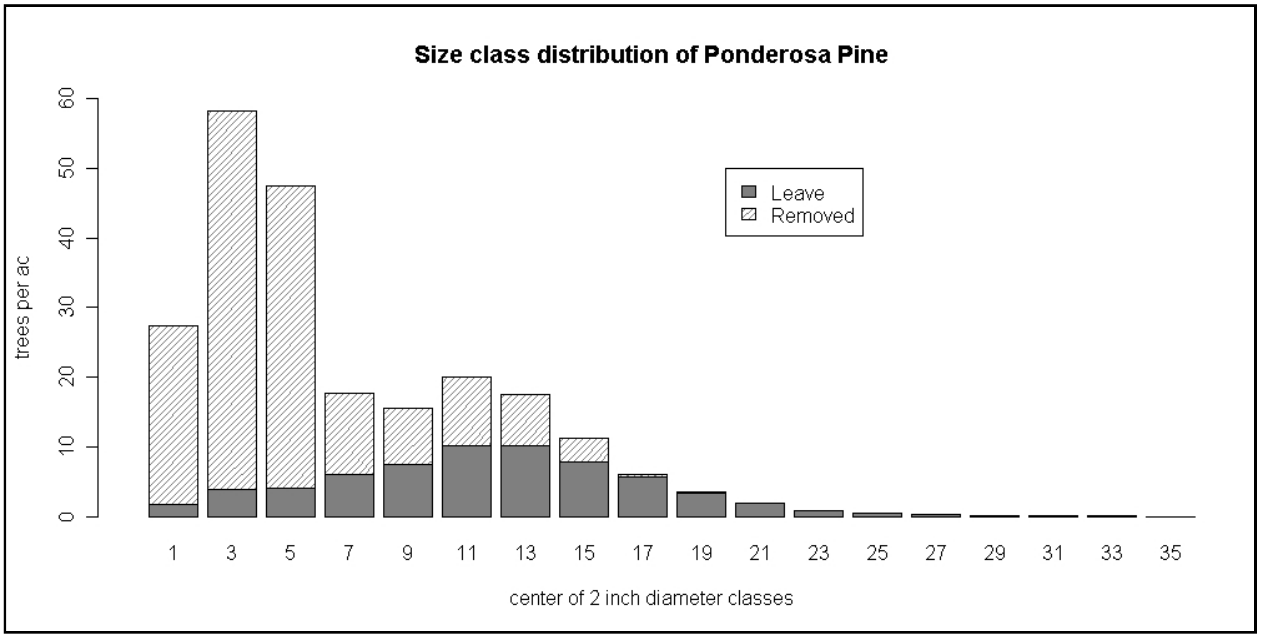
Restoration Vision

The vision for the ZML is *a landscape where the vegetation is resilient in the face of climate change, resistant to uncharacteristic crown fires, and supports healthy animal and human communities*. Restoration is the best tool available for achieving this vision. The overarching goal of restoration is to return forest communities to conditions that are within the natural range of variability, i.e., state that is within the spectrum of conditions that occurred before extensive modification of fire regime that occurred as Euroamericans settled the region. A restored landscape means restoration of ecosystem processes, particularly fire. Restoring fire as a natural process is the most effective and cost efficient way to ensure maintenance of healthy conditions.

Common goals of ponderosa pine restoration treatments include:

- Reduce the number of trees on the site;
- Restore cool, ground fires;
- Reduce the threat of crown fires;
- Protect wildlife habitat;
- Keep or promote old growth trees and a variety of tree structures (snags, logs);
- Maintain or improve soils and site productivity; and
- Generate income or increase potential to produce timber and other goods.

A size class distribution from a typical restoration thinning:



The restored ZML landscape will have fewer trees, but a greater percentage of large trees and over time more large, healthy, fire resistant trees. Trees will be clumped with open areas between them, as they were before the mid 1800s. The increased light and water availability after thinning will allow grass and herbs to recover. The landscape will also have more large snags, large down logs, and other features that support wildlife. A reduction in the number of trees will establish vegetation conditions that increase resilience to climate change and may increase water availability. Fire will burn on the restored landscape as low-severity ground fires that maintain the open condition.

The surrounding communities will be actively involved in the restored ZML landscape. People will be in the forest harvesting trees, gathering fire wood, hunting, fishing, hiking, and camping. They will be employed in forest based businesses that facilitate restoration and are supported by trees removed in the restoration process. Communities will be safer from wildfire because of the changes to the forest fuels.

Restoration Objectives

Forest restoration, based on landscape evidence within the project area (Grissino-Mayer and Swetnam 1997) and across the Southwest (Covington and Moore 1994, Allen et al. 2002, Friederici 2003) is driving the landscape vision.

Achieving the following suite of objectives will assist in realizing the landscape vision:

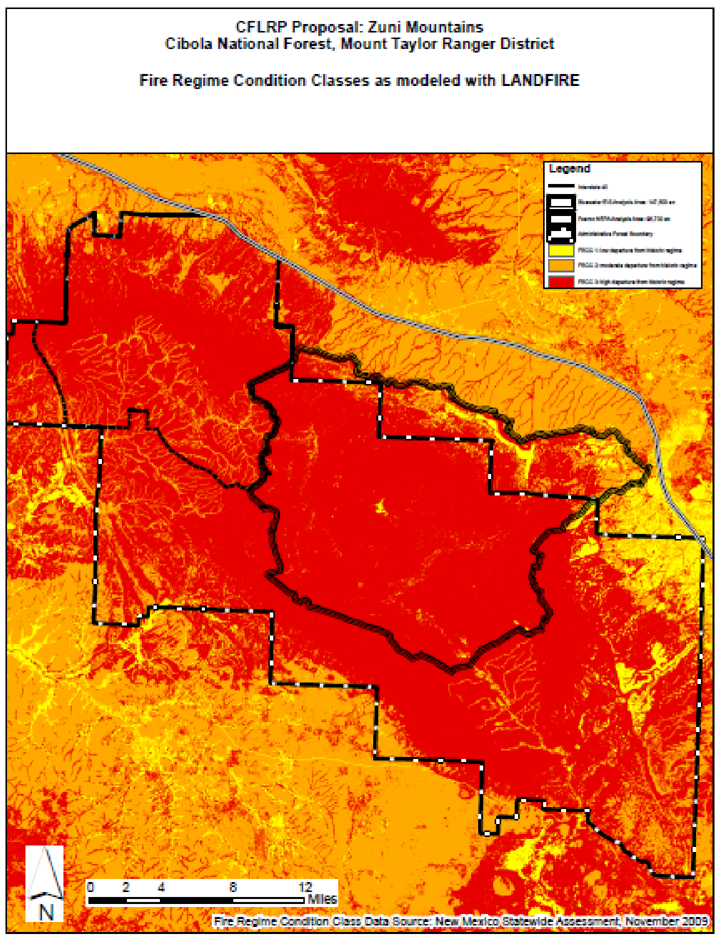
- Reduce uncharacteristic crown fire risk by restoring ecosystem structure and processes,
    - protect old and large trees
    - remove excess small trees
    - return fire to the ecosystems at appropriate intervals
- stabilize forest restoration-based businesses through a long term wood supply,
- improve hydrologic function,

  - reduce sublimation of snow fall (Essery et al. 2003)
  - increase water infiltration
  - and attenuate snow melt driven stream flow
- protect the ZBS, and
  - from post crown fire erosion events
  - reduce unauthorized use of roads near existing ZBS populations
  - establish vegetation conditions that may increase water availability
- sustain a restoration workforce in Cibola and McKinley counties through increased forest work and available wood fiber.

The restoration goal and objectives closely align with the New Mexico Forest Restoration Principles (see Appendix I). Developed over a 3 year period through an intensive and open collaborative process with a diverse group of stakeholders, including several members of the ZML collaborative, the principles provide a pathway for successful restoration and layout sideboards of the social license for forest restoration. Furthermore, the Bluewater EIS, the foundation of the ZML strategy and completed in 2003, served as a template for the NM Principles due to the Districts extensive efforts to collaborate with communities and forest scientists in the EIS planning.

Treatment Strategy

The strength of the ZML is with the maturity of the collaboration and the focus on utilization. The ZML strategy stems from over 5 years of collaboration between educators, non-profits, agencies, Tribes, and businesses through the Wood Industries Network (WIN). Established in 2005, WIN has been the forum for establishing restoration business partnerships, pursuing grants, contracts, and agreements across multiple land jurisdictions, and evaluating monitoring data and making management recommendations among other efforts. Despite the successes attributed to WIN since its inception, on the ground achievements have paled in comparison to the restoration needs of the landscape.



The highest risk to the health, resilience, and function of the ZML are large high intensity crown fire events. Such events put a variety of key ecosystem components in jeopardy. Given that 90% of the landscape is classified in FRCC III, or highly departed from its historic range of variability, the primary goal of the ZML strategy is to move the landscape towards FRCC I, or a low departure.

Treatment areas in the Bluewater watershed are already delineated in the 2003 Environmental Impact Statement (EIS). The Mt. Taylor Ranger District selected stands for restoration based on many factors including forest structure, fire history, access, and slope. In the Puerco project area, the planning process is underway and restoration treatments will be selected through a collaborative process with the multiparty team. The ZBS will be a focus of planning in the Puerco project area and will build on the ZBS Recovery Plan. Restoration of the forests in the upper Zuni River watershed will reduce the risk of high severity fire-eliminated ZBS populations and provide the best hope of increasing water availability for the ZBS (Baker 1999, Kaye et al 1999). Because sediment from roads poses a threat to ZBS, the project will reduce unauthorized use of limited-access roads near existing ZBS populations through new gates and other appropriate measures.

Due to high insurance costs and contracting and industry capacity limitations, New Mexico forest businesses have difficulty competing for Forest Service contracts, sales, and agreements and often lose work to larger, cheaper out-of-state firms. The ZML is in a unique position to direct a portion of the restoration work to local outfits using best value selection criteria through a 10 year Stewardship Agreement with the National Wild Turkey Federation which expires in 2019. During its first year, the Stewardship Agreement has contracted with local practitioners to restore 1,000 acres and utilize wood from restoration. The Rocky Mountain Elk Foundation, another conservation partner on the National Wild Turkey Federation Stewardship Agreement, donated $10,000 in 2010 to directly treat acres in ahead of prescribed burning. These thousand acres will also serve as a Forest Service Region 3 demonstration area to show the desired conditions for uneven age ponderosa pine management using the northern goshawk tree marking guidelines and provide for wildlife habitat and watershed improvement, forest health and hazardous fuels reduction. The Stewardship Agreement shows a commitment on the part of the Cibola National Forest and Region 3 that this proposal is more than just a single, isolated effort.

The Mt. Taylor Ranger District has been engaged in multiparty monitoring of socioeconomic and ecological indicators since at least 2005. District staff meet with multiparty monitors annually to review, interpret, and use monitoring data to affect management. In 2009, an adaptive management strategy was formally funded for the Bluewater II Collaborative Forest Restoration Program (CFRP) project. The ZML multiparty monitoring and adaptive management plan will expand upon these smaller scale CFRP monitoring efforts to monitor ecological and socioeconomic changes, and restoration effectiveness as well as build an adaptive management process to make use of the data.

Landscape Linkages

Linking centers of utilization and manufacturing capacity is essential to stimulate the growth of forest-based rural development in New Mexico. This linking of utilization and manufacturing centers between forested landscapes has already been identified as critical to the long term success of forested landscape restoration in New Mexico by USFS timber staff and the NM Forest and Watershed Restoration Institute. Forest-based collaboratives successfully bring together diverse interests to share common goals, identify and address barriers to rural economic development, and create economic and capacity efficiencies through increased communication and cooperation. An example of how forest-based collaboration can revive local economies is the Forest Guild's Wood Industries Network (WIN) in Grants, New Mexico. Prior to the creation of WIN, virtually no forest-based business capacity existed in the community and limited timber sales were occurring on the local national forests. Because of WIN and the collaboration between public, private, and community interests, a coordinated ecological and economic structure exists to restore forested acres and utilize wood products to support economic development goals.

New Mexico forest-based collaboratives exist within the ZML and surrounding regions. The following actions support growth and connectivity, particularly between the ZML and the Jemez Mountains (site of the SW Jemez CFLRP project), of forest based-industry centers leading to a functional forest-based industry network.

(1) Identify Forest industry stakeholders in forest industry zones (ZML and the Jemez)
   (a) Forest-dependent communities' ecosystem service goals, needs, and gaps.
   (b) Public and private forested area wood supplies and existing management goals.
   (c) Forest industry capacity, goals, needs, and gaps.
   (d) Partner assets, resource needs, and barriers to success related to the above.
(2) Define integrated, triple bottom line, cross-jurisdictional Hub forest industry zones.
   (a) Develop and implement long-term forest stewardship plans, agreements, and/or contracts.
   (b) Develop, enhance, and integrate businesses—bolstered by the assistance action programs described above—to sustainably steward local and regional forest resources and capture multiple forest value streams.
   (c) Address forest restoration, watershed protection, recreation, and other high priority community needs.
   (d) Address equipment and facility capacity issues (infrastructure development, transportation, utilization)
(3) Provide technical forestry assistance for cost-effective equipment selection and operation, mill set up/operation, and other topical issues. Training will include hands-on operations and mentoring.
(4) Provide on-the-ground training for contractors regarding sustainable forestry, forest restoration, and silvicultural prescription development and implementation.
(5) Provide business assistance and mentoring in needed areas including project costing, financial management, bid development, web marketing, and insurance.
(6) Address the need for capitalization assistance by identifying forestry business financing mechanisms so that small forest businesses can access loans for investment capital. Develop an advisory subcommittee from among the project partners to work with the lending entity on program implementation and to provide forestry technical expertise to guide loan-making decisions.

By increasing stakeholder collaboration and linking forest-based industry capacities between the ZML and the Jemez Mountains, significant barriers to forest industry growth in New Mexico will be eliminated. As part of the ZML and Jemez CFLRP projects, forested acres and treatments to meet landowner and community needs are identified and contractors will be supplied with access to wood supply and reliable work. Marketing opportunities for local wood products will be identified and small businesses provided with the assistance needed to engage potential buyers.

The collaborator liaison position, described in detail in the monitoring section will engage with the Jemez Mountain collaborative to realize the landscape linking goals and objectives outline above. To realize the ecological and socioeconomic elements of the ZML strategy, the collaborators will continue to use best value contracting authorities to support local wood harvesting and utilization businesses paired with support from municipal and county government's loan assistance program tools to enable these businesses to grow in response to the available acres and material.

Thinning and Prescribed Fire Treatments

Piñon-juniper, ponderosa pine, and mixed conifer forests are the three major types in need of stand appropriate restoration treatments to address undesirable conditions in forest structure, composition, and role of fire (or lack thereof) on the landscape.[2]

The District anticipates service work to help attain the desired future conditions such as thinning trees less than 5 inches in diameter or hand thinning in Mexican Spotted Owl protected activity centers of trees less than 9 inches in diameter.

The most important tool available to move the landscape away from the undesirable and towards the desired conditions is fire. Dr. Grissino-Mayer (2011, Pers. Com.), the foremost fire ecologist for the ZML emphasized that the return of low intensity fire to the landscape is the highest restoration need, particularly in ponderosa pine and mixed conifer. The return low intensity fire to the ZML is predicated by the removal overabundant small and young trees. The following desired conditions describe where the ZML collaborative hopes to move the landscape toward.

Piñon-Juniper Desired Conditions

The Piñon-Juniper (PJ) vegetation community is collectively composed of the Juniper Grassland, PJ Grassland, PJ Sagebrush, PJ Evergreen Shrub, and PJ Woodland (persistent) Potential Natural Vegetation Types. These generally occur at elevations between approximately 4500 and 7500 feet. They are dominated by one or more species of piñon pine and/or juniper and can occur with a grass/forb dominated understory (PJ grassland), a shrub dominated understory (PJ sagebrush/evergreen shrub), or a sparse discontinuous understory of some grasses and/or shrubs (PJ persistent woodland). Two-needle, single-leaf, Mexican, and border piñon pine are common; as well as one-seed, Utah, redberry, Rocky Mountain, and alligator junipers, and a lesser abundance of oaks. Species composition and stand structure vary by location primarily due to precipitation, elevation, temperature, and soil type.

Desired conditions for Piñon-Juniper Grassland and Juniper Grassland are where the vegetation would be generally uneven aged and open in appearance. Trees would occur as individuals, but occasionally in smaller groups, and range from young to old. Scattered shrubs and a dense herbaceous understory including native grasses, forbs and annuals would be present to support frequent surface fires. Snags would also be scattered across the landscape. The composition,

[2] A chart of proposed treatments can be accessed here, http://www.forestguild.org/CFLRP/Documents/ZML_TreatmentChart.pdf.

structure, and function of vegetative conditions would be resilient to the frequency, extent and severity of disturbances (e.g. insects, diseases, and fire) and climate variability. The systems would be FRCC I, a low departure from historic conditions, and have frequent low-severity fire events.

Desired conditions in Piñon-Juniper Sagebrush would be when a mix of trees and shrubs occur in a series of vegetation states that move from herbaceous-dominated to shrub-dominated to tree-dominated over time. Trees would occur as individuals or in smaller groups ranging from young to old. Piñon trees may occasionally be absent but one or more juniper species is always present. Typically groups would be even-aged in structure. The understory would be dominated by moderate to high density shrubs depending on successional stage. The shrub component will consist of one or a mix of sagebrush, evergreen shrub, oak, and other shrub species, which are well-distributed. Shrubs typically can be in a closed canopy state during the later successional stages. Native perennial grasses and annual and perennial forbs would be present as a sparse understory component. Snags and old trees with dead limbs/tops may be scattered across the landscape. Large dead wood should be present. The composition, structure, and function of vegetative conditions are expected to be resilient to the frequency, extent and severity of disturbances (e.g. insects, diseases, and fire) and climate variability. Fires will typically infrequent and of a high severity.

Desired conditions for the Piñon-Juniper Evergreen Shrub type would be a mix of trees and shrubs that occurs as a series of vegetation states that move from herbaceous-dominated to shrub-dominated to tree-dominated over time. Trees occur as individuals or in smaller groups ranging from young to old. Piñon trees are occasionally absent but one or more juniper species is always present. Typically groups are even-aged in structure with all ages represented across the landscape for an overall uneven-aged grouped appearance. The understory is dominated by low to moderate density shrubs depending on successional stage. The shrub component consists of one or a mix of evergreen shrub, oak, manzanita, mountain mahogany, sumac and other shrub species, which are well-distributed. Native perennial grasses and annual and perennial forbs are present in the interspaces. Snags and old trees with dead limbs/tops are scattered across the landscape. Large dead wood is present. The composition, structure, and function of vegetative conditions are resilient to the frequency, extent and severity of disturbances (e.g. insects, diseases, and fire) and climate variability. Fires are typically mixed severity with a moderate frequency. Some evergreen shrub types exhibit occasional high severity fires.

Desired conditions for the Piñon-Juniper Woodland (persistent) type would be characterized by even-aged patches of piñons and junipers that at the landscape level form multi-aged woodlands. Very old trees (>300 years old) are present. “Old growth” occurs as patches on the landscape. Tree density and canopy cover are high, shrubs are sparse to moderate, and herbaceous cover is low and discontinuous. Snags and older trees with dead limbs and/or tops are scattered across the landscape. The composition, structure, and function of vegetative conditions are resilient to the frequency, extent and severity of disturbances (e.g. insects, diseases, and fire) and climate variability. Insects and disease occur at endemic levels. Fire as a disturbance is less frequent and variable due to differences in ground cover. The fires that do occur are mixed to high severity.

Ponderosa Pine Desired Conditions

At the landscape scale (10,000 + acres), the ponderosa pine forest vegetation community is composed of trees from structural stages ranging from young to old. “Old growth” is well distributed in the landscape. Forest appearance is variable but generally uneven-aged and open; occasional areas of even-aged structure are present. The forest arrangement is in individual trees, small clumps, and groups of trees interspersed within variably-sized openings of grass/forbs/shrubs vegetation associations similar to historic patterns. Openings typically range from 10 percent in more productive sites to 70 percent in the less productive sites. Size, shape, number of trees per group, and number of groups per area are variable across the landscape. In the Gambel oak sub-type, all sizes and ages of oak trees are present. Denser tree conditions exist in some locations such as north facing slopes and canyon bottoms.

The ponderosa pine forest vegetation community is composed predominantly of vigorous trees, but declining trees are a component and provide for snags, top-killed, lightning- and fire-scarred trees, and coarse woody debris (>3 inch diameter), all well-distributed throughout the landscape. Ponderosa pine snags are typically 18 inches or greater at DBH and average 1 to 2 snags per acre. In the Gambel oak subtype, large oak snags (>10 inches) are a well-distributed component. Downed logs (>12 inch diameter at mid-point, >8 feet long) average 3 logs per acre within the forested area of the landscape. Coarse woody debris, including downed logs, ranges from 3 to 10 tons per acre.

The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances and climate variability. The landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g. insects, diseases, fire, and wind), including snags, downed logs, and old trees. Grasses, forbs, shrubs, and needle cast (fine fuels), and small trees maintain the natural fire regime. Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and to ecosystem function. Frequent, low severity fires are characteristic in this type, including throughout goshawk home ranges. Natural and anthropogenic disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling.

At the mid-scale (100 –1,000 acres) the ponderosa pine forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. The more biologically productive sites contain more trees per group and more groups per area, resulting in less space between groups. Openings typically range from 10 percent in more productive sites to 70 percent in the less productive sites. Tree density within forested areas generally ranges from 20 to 80 square foot basal area per acre.

The mosaic of tree groups generally comprises an uneven-aged forest with all age classes present. Infrequently patches of even-aged forest structure are present. Disturbances sustain the overall age and structural distribution. Fires burn primarily on the forest floor and do not spread between tree groups as crown fire.

At the stand to multi-group scale (< 10 acres) trees typically occur in irregularly shaped groups and are variably-spaced with some tight clumps. Crowns of trees within the mid-aged to old groups are interlocking or nearly interlocking. Openings surrounding tree groups are variably-shaped and comprised of a grass/forb/shrub mix. Some openings contain individual trees. Trees within groups are of similar or variable ages and may contain species other than ponderosa pine. Size of tree groups typically is less than 1 acre, but averages .5 acres. Groups at the mid-aged to old stages consist of 2 to approximately 40 trees per group.

Dry Mixed Conifer Desired Conditions
At the landscape scale (10,000 + acres), the dry mixed conifer vegetation community is a mosaic of forest conditions composed of structural stages ranging from young to old trees. Old-growth is well-distributed in the landscape. Forest appearance is variable but generally uneven-aged and open; occasional patches of even-aged structure are present. The forest arrangement is in small clumps and groups of trees interspersed within variably-sized openings of grass/forb/shrub vegetation associations similar to historic patterns. Size, shape, number of trees per group, and number of groups per area are variable across the landscape. Where they naturally occur, groups or patches of aspen and all structural stages of oak are present. Denser tree conditions exist in some locations such as north facing slopes and canyon bottoms.

The dry mixed conifer forest vegetation community is composed predominantly of vigorous trees, but declining trees are a component and provide for snags, top-killed, lightning- and fire-scarred trees, and coarse woody debris (>3 inch diameter), all well-distributed throughout the landscape. Snags are typically 18 inches or greater at DBH and average 3 per acre. Downed logs (>12 inch diameter at mid-point, >8 feet long) average 3 per acre within the forested area of the landscape. Coarse woody debris, including downed logs, ranges from 5 to 15 tons per acre.

The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, severity of disturbances, and to climate variability. The landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g. insects, diseases, fire, and wind), including snags, downed logs, and old trees. Grasses, forbs, shrubs, needle cast (fine fuels), and small trees maintain the natural fire regime. Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and to ecosystem function. Frequent, low severity fires are characteristic, including throughout goshawk home ranges. Natural and anthropogenic disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling.

At the mid-scale (100 –1,000 acres) the dry mixed conifer forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. The more biologically productive sites contain more trees per group and more groups per area. Openings typically range from 10 percent in more productive sites to 50 percent in the less productive sites. Tree density within forested areas generally ranges from 30 to 100 square foot basal area per acre. Forest structure in the wildland urban interface (WUI) has smaller and more widely spaced groups of trees than in the non-WUI areas.

The mosaic of tree groups generally comprises an uneven-aged forest with all age classes and structural stages. Occasionally small patches (generally less than 50 acres) of even-aged forest structure are present. Disturbances sustain the overall age and structural distribution. Fires burn primarily on the forest floor and do not spread between tree groups as crown fire.

At the stand to multi-group scale, trees typically occur in irregularly shaped groups and are variably-spaced with some tight clumps. Crowns of trees within the mid-aged to old groups are interlocking or nearly interlocking. Openings surrounding tree groups are variably-shaped and comprised of a grass/forb/shrub mix. Some openings contain individual trees or snags. Trees within groups are of similar or variable ages and one or more species. Size of tree groups typically is less than 1 acre. Groups at the mid-age to old stages consist of 2 to approximately 50 trees per group.

Wet Mixed Conifer Desired Conditions
The Wet Mixed Conifer forest vegetation community is a mosaic of structural and seral stages ranging from young trees through old. The landscape arrangement is an assemblage of variably-sized and aged groups and patches of trees and other vegetation associations similar to historic patterns. Tree groups and patches are comprised of variable species composition depending on forest seral stages. An approximate balance of seral stages is present across the landscape, each seral stage characterized by distinct dominant species composition and biophysical conditions. Old-growth is well-distributed in the landscape. Canopies are generally more closed than in dry mixed conifer. An understory consisting of native grass, forbs, and/or shrubs is present.

The Wet Mixed Conifer forest vegetation community is composed predominantly of vigorous trees, but older declining trees are a component and provide for snags, top-killed, lightning- and fire-scarred trees, and coarse woody debris, all well-distributed throughout the landscape. Number of snags and the amount of downed logs (>12 inch diameter at mid-point, >8 feet long) and coarse woody debris (>3 inch diameter) vary by seral stage.

The composition, structure, and function of vegetative conditions are resilient to the frequency, extent and severity of disturbances and climate variability. The forest landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g. insects, diseases, wind, and fire), including snags, downed logs, and old trees. Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and to ecosystem function. Mixed severity fire is characteristic. High severity fires rarely occur. Natural and anthropogenic disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling.

At the mid-scale, the size and number of groups and patches vary depending on disturbance, elevation, soil type, aspect, and site productivity. Patch sizes vary but are frequently in the hundreds of acres, with rare disturbances in the thousands of acres. Groups and patches of tens of acres or less are relatively common. A mosaic of groups and patches of trees, primarily even-aged, and variable in size, species composition, and age is present. Grass, forb, shrub openings created by disturbance, may comprise 10 to 100 percent of the mid-scale area depending on the disturbances and on time since disturbance. Aspen is occasionally present in large patches.

Density ranges from 20 to 180 square foot basal area per acre depending upon time since disturbance and seral stages of groups and patches. Snags 18 inches or greater at DBH range from 1 to 5 snags per acre, with the lower range of snags of this size associated with early seral stages and the upper range associated with late seral stages. Snag density in general (>8 inches

DBH) averages 20 per acre. Coarse woody debris, including downed logs, vary by seral stage, with averages ranging from 5 to 20 tons per acre for early-seral stages; 20 to 40 tons per acre for mid-seral stages; and 80 tons per acre or greater for late-seral stages.

Mixed and high severity fires and other disturbances maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling. High severity fires generally do not exceed 1000 acre patches of mortality. Other smaller disturbances occur more frequently. Forests in the wildland urban interface (WUI) are dominated by early-seral fire-adapted species growing in an overall more open condition than the general forest. These conditions result in fires that burn primarily on the forest floor and rarely spread as crown fire.

At the stand scale in mid-aged and older forests trees are typically variably-spaced with crowns interlocking (grouped and clumped trees) or nearly interlocking. Trees within groups can be of similar or variable species and ages. Small openings (gaps) are present as a result of disturbances.

Invasive Plant Control
Current populations, extent, and ecological damage of noxious weeds and invasive plants remain nominal. However, given the uncertainties of climate change and the law of unintended consequences, especially with widespread restoration thinning and burning, the Cibola National Forest's recent forest-wide Environmental Assessment resulted in a Decision Notice and a Finding of No Significant Impact for the herbicidal control of noxious and invasive plants is forward thinking. The ability to preemptively suppress the populations and extent of invasive plants and noxious weeds will protect the ZML from unwanted ecological damage and stress.

Wildlife Habitat
Restoration will improve habitat for a range of wildlife species by returning forests to the conditions for which they are adapted to. Species of attention in the area in addition to the Zuni Bluehead Sucker include the northern goshawk (*Accipiter gentilis*) and Mexican spotted owl (MSO; Strix occidentalis lucida). Forest conditions in goshawk post-fledging family areas (PFAs) are similar to general forest conditions except these forests contain 10 to 20 percent higher tree density (basal area) than goshawk foraging areas and the general forest. Nest areas have forest conditions that are multi-aged but are dominated by large trees with relatively dense canopies. These treatments follow on the management recommendations for northern goshawk (Reynolds 1992).

Similarly, forest conditions for MSO nest and roost habitat are consistent with the restricted habitat requirements specified in the MSO Recovery Plan (USFWS 1995). In accordance with the MSO Forest Plan direction, the District will track gross changes in acres of owl habitat resulting from natural and human caused disturbances. Acreage changes in vegetation composition, structure, and density should be tracked, evaluated, and reported.

In protected and restricted MSO areas where silvicultural or fire abatement treatments are planned, treated stands will be monitored pre and post treatment to determine changes end trajectories in fuel levels; snag basal areas; live tree basal areas; volume of down logs over 12 inches in diameter; and basal area of hardwood trees over 10 inches in diameter at the root crown.

Old Growth

Old growth stand characteristics have been observed to be poorly distributed across the landscape and across the dominant vegetation types. The previously stated desired future conditions call for increased old growth stand characteristics across the ZML.

Given the stakeholder's long association with the CFRP, whose enabling legislation requires the protection or old and large trees wherever they occur, and the stakeholders association with the NM Restoration Principles, the ZML treatments will protect old and large trees across the landscape. The treatments will also move stands and patches towards old growth conditions by protecting large trees and releasing suppressed trees.

Roads

The growing number of vehicles on National Forest System lands is increasing the impacts to national forests and grasslands' natural and cultural resources. Resource management goals are no longer combatable with unrestricted motorized cross-country travel. The new Environmental Assessment for Travel Management on the Mt. Taylor Ranger District (2011) will help designate those roads, trails, and areas open to motor vehicle use by type of vehicle and, if appropriate, time of year. Work within the ZML will ensure that routes and areas identified on the motor vehicle use map are properly designated in the field. The ZML will still include wide opportunities for non-motorized activities such as camping, hunting, hiking, mountain biking, and horseback riding and the road system will allow for motorized access, though routes available may change. The District will facilitate access by local tribes to maintain their cultural and traditional uses. The proposed travel management plan includes changing 328 miles of roads that are currently open to public motorized use to administrative use only. Other road closures, designation changes, and new routes will help protect soils, water quality, wildlife habitat, and archaeological resources. For example, restricting access to roads near existing ZBS populations will help protect quality for this species' survival.

Non-NFS Lands

There have also been significant non-federal investments within and surrounding the ZML that are expected to continue such as:

- monitoring of ZBS populations by the NM Department of Game and Fish,
- stream restoration and monitoring by NM Environment Department, NM State Land Office, Cottonwood Gulch Foundation, and WildEarth Guardians,
- private landowner thinning and wood utilization projects through assistance from the Bernalillo District of NM State Forestry, McKinley and Lava Soil and Water Conservation Districts, and the NM Forest and Watershed Health Office,
- forest restoration thinning and wood utilization by the New Mexico State Land Office,
- trail maintenance and infrastructure by volunteer mountain biker user groups, and
- the state-funded Forest Guild Youth Conservation Corp crew who assist the District on range, forestry, and recreation efforts.

These efforts are expected to continue and potentially expand. If wood utilizers and restoration thinning businesses become stabilized through CLFRP funding, the costs of thinning will be reduced and the value of wood products will increasingly be able to pay their way out of the forest as their markets become stabilized.

Implementation Readiness

This project is implementation-ready through 2017. There are National Environmental Policy Act (NEPA) "ready" thinning and burning acres through 2017. There are seven current National Environmental Policy Act decisions or findings in the landscape. These are:

- 1999: Mt. Sedgwick/Bluewater Allotments Environmental Assessment
- 1999: Bluewater Creek Improvement Project
- 2000: Oso Thinning Project
- 2002: Bluewater Creek Riparian Restoration Project
- 2002: Bluewater Road Realignment
- 2003: Bluewater Watershed Environmental Impact Statement
- 2010: Integrated Pest Management of Noxious/Invasive Plants Environmental Assessment
- 2011: Agua Media-Copperton Ponderosa Pine Restoration Categorical Exclusion

There are several strengths to the proposed funding plan that relate to the financial burden on the Forest or Region, implementation mechanisms, and appropriateness of the request. The treatments are anticipated to significantly move the landscape towards FRCC I and stabilize restoration businesses without burdening the Cibola or Region 3 with the generation of millions of dollars of matching funds.

The District and the Forest can provide for matching funds to the CFLRP funding within its current budget capacity without asking or expecting for contributions from the Region to make this project work. In a federal fiscal environment where funding is moving towards competitive allocation while base funding is often diminishing, the ability of the various Regions around the country is becoming limited to supply additional matching funds for landscape scale projects.

Additionally, the presence of the Stewardship Agreement with the National Wild Turkey Federation that is already in place will expedite implementation and avoid challenges such as the tying up of cash for a cancellation ceiling associated with long term Stewardship Contracting. This increases the likelihood of success.

Expected Outcomes

Watersheds

The proposed treatments, implemented at the watershed scale, will improve water quality and quantity. Wildfire risk, the biggest threat to soil stability and hydrologic function, will be significantly reduced by the proposed treatments. By reducing stand density, greater snow pack retention can be achieved, thus, reducing moisture loss due to sublimation. The proposed treatments will also move stand structure to a point where snow retention will attenuate snow melt driven stream flow and enable more moisture to infiltrate the soil. In the face of climate change, the ability to manage scarce water resources is a critical outcome of the proposed treatments.

Wildfires

A restored landscape that is resilient to fire and allows for managing natural ignitions will result in reduced fire suppression costs and rehabilitation costs. Suppression costs for Region 3 for the past 20 years averaged $251 per acre versus $112 per acre for managing unplanned ignitions by responses other than full suppression. Snider et al. (2006) found that hazardous fuels reduction treatments can save $238-600 per acre in future suppression costs alone. Some economic cost analyses that were conducted on similar landscapes calculated potential present net value change in rehabilitation and fire damage costs for high value areas as high as $929 per acre. Simulations have found that the acres burned and associated costs are exponentially reduced in treated areas as compared to non-treated areas (Omi and Martinson 2002, Pollet and Omi 2002). A forest in the Region has estimated costs of managing fires to meet resource objectives to range from $35-209 per acre (estimate from Gila National Forest). Considering these figures, the ability to use unplanned fire in this area could result in significant cost savings.

Additionally, a restored landscape will provide more opportunity to manage unplanned ignitions under a wider array of responses other than full suppression. The Wildland Decision Support System (WFDSS) will be used for all unplanned ignitions to guide and document wildfire management decisions. Full suppression may still occur; however, unplanned ignition will gradually be used more as a tool for maintaining forest and meadow ecosystems in this area.

Socioeconomic

Cibola and McKinley counties have unemployment rates higher than the state and nation. Sustaining or creating restoration related jobs will significantly improve the socioeconomic conditions of the landscape. Paired with the jobs, the landscape restoration effort will stabilize and grow local businesses.

Wood utilizers are currently handling wood from approximately 7000 acres per year. Both the wood harvesters and the wood utilizers from the ZML currently treat acres and procure wood from outside the ZML to account for the imbalances between the costs of reduced cost acres and their availability in the ZML and between acres treated in the ZML and acres of wood supply needed.

Implementation of the ZML strategy will guarantee subsidized acres and material using active stewardship authorities that will enable these businesses to stabilize and grow. The subsidies are needed due to the depressed wood markets (due to the 2008 Recession's effects on the housing markets and low cost foreign imports) and the inability of the woody by-products from restoration to sufficiently offset treatment costs. It is anticipated that after 10 years the wood harvesters and utilizers will have stabilized to the point mechanical treatments will require no to nominal subsidization.

Investments in fuels reduction on Forest Service lands act as an economic stimulus to rural communities and have been shown to generation millions of dollars of economic output as well as hundreds of jobs sustained or created (Hjerpe and Kim 2008). Similar results are expected to result from implementation of the proposed treatments and the ZML strategy. The TREAT model anticipates the creating or sustaining 62 direct, indirect, and induced jobs per project year. Findings from the 5 year multiparty monitoring report from the White Mountain Stewardship Contract, also in Region 3 also indicate that wood utilization businesses will make additional capital investments and hire more people. The anticipated ripple effect in the economies local to the ZML is likely to have a greater impact due to their already economically depressed condition and accompanying high unemployment rates.

The park-like conditions associated with a restored forest are often favored by active and passive recreationists and vehicular tourism. Tourism to and across the ZML has a recognized benefit to the local economies (CRC & Associates 2007; La Rouche 2001; and IAFWA 2002). In addition to tourism, quality active and passive recreation provides significant benefits to local economics. Since 2009 mountain biking use in the ZML has increased dramatically with the introduction of a 24 hour race event. This event, supported by the NM Council of Governments Economic Development Department, brings cyclists to the ZML from around the western states and is accompanied by volunteer trail maintenance. Continuation and expansion of active recreation such as this will strengthen the local economic stimulus.

References

Albert, S., N. Luna, R. Jensen, and L. Livingston. 2004. Restoring Biodiversity to Piñon-Juniper Wodlands. *Ecological Restoration* 22(1):18-23.

Allen, C. D., M. Savage, D. A. Falk, K. F. Suckling, T. W. Swetnam, et al. 2002. Ecological restoration of southwestern ponderosa pine ecosystems: A broad perspective. *Ecological Applications* 12(5):1418-1433.

Baker, M. B., Jr. 1986. Effects of Ponderosa Pine Treatments on Water Yield in Arizona. *Water Resour. Res.* 22(1):67-73.

Bentz, B. J., J. Régnière, C. J. Fettig, E. M. Hansen, J. L. Hayes, et al. 2010. Climate Change and Bark Beetles of the Western United States and Canada: Direct and Indirect Effects. *Bioscience* 60(8):602-613.

Berrens, R., J. Talberth, J. Thacher, and M. Hand. 2006. *Economic and community benefits of protecting New Mexico's inventoried roadless areas*. Center for Sustainable Economy, Santa Fe, NM.

Carmen, Stephanie M. 2004. Zuni Bluehead sucker (Catostomus discobolus yarrowi) Recovery Plan. New Mexico Department of Game and Fish, Conservation Services Division. Santa Fe, NM.

Cooper, C. F. 1960. Changes in vegetation, structure, and growth of southwestern pine forests since white settlement. *Ecology* 42:493-499.

Covington, W. W. 2003. The evolutionary and historical context. *in* P. Friederici, editor. *Ecological restoration of southwesternponderosa pine forests*. Island Press, Washington, DC.

Covington, W. W., and M. M. Moore. 1994. Southwestern ponderosa forest structure: changes since Euro-American settlement. *Journal of Forestry* 92(1):39-47.

CRC & Associates. 2007. *Recreational visitors to New Mexico*. Bernalillo, NM.

Dick-Peddie, William A. 1993. *New Mexico Vegetation: past, present, and future.* University of New Mexico Press, Albuquerque, NM.

Dominguez, F., J. CaÃ±on, and J. Valdes. 2010. IPCC-AR4 climate simulations for the Southwestern US: the importance of future ENSO projections. *Climatic Change* 99(3):499-514.

ENMRD Forestry Division. 2010. *New Mexico Statewide Natural Resource Assessment & Strategy and Response Plans*. State of New Mexico, Energy, Minerals, and Natural Resources Department, Forestry Division, Santa Fe, NM.

Essery, R., J. Pomeroy, J. Parviainen, and P. Storck. 2003. Sublimation of Snow from Coniferous Forests in a Climate Model. *Journal of Climate* 16(11):1855-1864.

Evans, A. M., and A. J. Finkral. 2009. From renewable energy to fire risk reduction: a synthesis of biomass harvesting and utilization case studies in US forests. *Global Change Biology Bioenergy* 1(3):211-219.

Fiedler, C. E., and C. E. Keegan. 2003. Reducing crown fire hazard in fire-adapted forests of New Mexico. Pages 39-48 in P. N. Omi and L. A. Joyce, editors. *Fire, Fuel Treatments, and Ecological Restoration*. USDA Forest Service, Fort Collins, CO.

Friederici, P. (ed.). 2003. Ecological restoration of southwestern ponderosa pine forests. Island Press, Washington, D.C. 561 pp.

Grissino-Mayer, Henri D.; Swetnam, Thomas W. 1997. *Multi-century history of wildfire in the ponderosa pine forests of EL Malpais National Monument.* New Mexico Bureau of Mines & Mineral Resources, Bulletin 156.

Grissino-Mayer, Henri D. 2011. Personal Communication. University of Tennessee, Knoxville.
Hjerpe, E. E., and Y.-S. Kim. 2008. Economic Impacts of Southwestern National Forest Fuels Reductions. Journal of Forestry 106(6):311-316.
Hunter, M. E., W. D. Shepperd, J. E. Lentile, J. E. Lundquist, M. G. Andreu, et al. 2007. *A comprehensive guide to fuels treatment practices for ponderosa pine in the Black Hills, Colorado Front Range, and Southwest*. RMRS-GTR-198, USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO.
IAFWA. 2002. *Economic Importance of Hunting in America*. International Association of Fish and Wildlife Agencies, Washington, DC.
IPCC. 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Eds. R.K. Pachauri and A. Reisinger.*, Geneva, Switzerland.
Johnson, M. 1994. Changes in Southwestern forests: Stewardship implications. *Journal of Forestry* 92(12):16-19.
Kaye, J. P., S. C. Hart, R. C. Cobb, and J. E. Stone. 1999. Water and Nutrient Outflow Following the Ecological Restoration of a Ponderosa Pine-Bunchgrass Ecosystem. *Restoration Ecology* 7(3):252-261.
La Rouche, G. P. 2001. *Birding in the United States: A Demographic and Economic Analysis*. 2001-1, US Fish and Wildlife Service, Washington, DC.
LANDFIRE. 2010. *Fire Regime Condition Class*. U.S. Department of Interior, Geological Survey. Last Accessed January 3, 2011.http://landfire.cr.usgs.gov/viewer/
Lynch, D. L., W. H. Romme, and M. E. Floyd. 2000. Forest restoration in southwestern ponderosa pine. *Journal of Forestry* 98(8):17-24.
Mansourian, S., and D. Vallauri (eds.). 2005. Forest restoration in landscapes: Beyond planting trees. Springer, New York. 437 pp.
Millar, C., N. Stephenson, and S. Stephens. 2007. Climate change and forests of the future: Managing in the face of uncertainty. *Ecological Applications* 17(8):2145–2151.
Moore, M. M., D. W. Huffman, P. Z. Fulé, W. W. Covington, and J. E. Crouse. 2004. Comparison of Historical and Contemporary Forest Structure and Composition on Permanent Plots in Southwestern Ponderosa Pine Forests. *Forest Science* 50(2):162-176.
Morgan, T. A., T. Dillon, C. E. Keegan III, A. L. Chase, and M. T. Thompson. 2006. *The Four Corners timber harvest and forest products industry, 2002*. RMRS-RB-7. , USDA Forest Service. Rocky Mountain Research Station, Fort Collins, CO.
Noss, R. F., J. F. Franklin, W. L. Baker, T. Schoennagel, and P. B. Moyle. 2006. Managing fire-prone forests in the western United States. *Frontiers in Ecology* 4(9):481–487.
Omi, P. N., and E. J. Martinson. 2002. *Effect of fuel treatment on wildfire severity*. Western Forest Fire Research Center, Colorado State University, Fort Collins, CO.
Pollet, J., and P. N. Omi. 2002. Effect of thinning and prescribed burning on crown fire severity in ponderosa pine forests. *International Journal of Wildland Fire* 11(1):1-10.
Reynolds, R. T., R. T. Graham, and M. H. Reiser. 1992. Management Recommendations for the Northern Goshawk in the Southwestern United States. GTR-RM-217. USDA Forest Service. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, CO.
Rietbergen-McCracken, J., S. Maginnis, and A. Sarre. 2008. The forest landscape restoration handbook. Earthscan Publications Ltd., New York. 190 pp.
Russell, John and Adams-Russell, Peggy A. 2005. Values, Attitudes and Beliefs Toward National Forest System Lands: The Cibola National Forest. USDA Forest Service. 48 pp.

Sauer, L. 1998. The once and future forest: A guide to forest restoration strategies. Island Press, Washington, D.C. 400 pp.
Sedell, J., M. Sharpe, D. Apple, M. Copenhagen, and M. Furniss. 2000. *Water and the Forest Service*. FS-660, USDA Forest Service, Washington, D.C.
Sitko, S. and S. Hurteau. 2010. Evaluating the Impacts of Forest Treatments: The First Five Years of the White Mountain Stewardship Project. The Nature Conservancy. Phoenix, Arizona.
Snider, G., P. J. Daugherty, and D. Wood. 2006. The irrationality of continued fire suppression: an avoided cost analysis of fire hazard reduction treatments versus no treatment. *Journal of Forestry* 104(8):431-437.
Stankey, G. H., R. N. Clark, and B. T. Bormann. 2005. Adaptive management of natural resources: Theory, concepts and management institutions. General Technical Report, PNW-GTR-654, USDA Forest Service, Pacific Northwest Research Station, Portland, OR. 73 pp.
Swetnam, T. W., and J. L. Betancourt. 1998. Mesoscale Disturbance and Ecological Response to Decadal Climatic Variability in the American Southwest. *Journal of Climate* 11(12):3128-3147.
University of New Mexico Bureau of Business and Economic Research (UNM-BBER). 2007. Socioeconomic Assessment of the Cibola National Forest.
US Census Bureau. 2010. *2005-2009 American Community Survey 5-Year Estimates* http://factfinder.census.gov
USFWS. 1995. Recovery Plan for the Mexican Spotted Owl. USDI Fish and Wildlife Service, Albuquerque, NM.
USFS. 2010. Environmental Assessment for Travel Management on the Mt. Taylor Ranger District. MB-R3-03-11. USDA Forest Service, Southwestern Region.
USFWS, and US Census Bureau. 2006. *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: New Mexico.* U.S. Fish and Wildlife Service and U.S. Census Bureau, Washington, DC.
Wagner, H. H. and M.-J. Fortin. 2005. Spatial analysis of landscapes: concepts and synthesis. Ecology 86: 1975-1987.
Westerling, A., and B. Bryant. 2008. Climate change and wildfire in California. *Climatic Change* 87(0):231-249.
Westerling, A. L., H. G. Hidalgo, D. R. Cayan, and T. W. Swetnam. 2006. Warming and Earlier Spring Increases Western U.S. Forest Wildfire Activity. *Science* 313(5789):940-943.
Williams, A. P., C. D. Allen, C. I. Millar, T. W. Swetnam, J. Michaelsen, et al. 2010. Forest responses to increasing aridity and warmth in the southwestern United States. *Proceedings of the National Academy of Sciences* 107(50):21289-21294.

Appendix I

New Mexico Forest Restoration Principles

Preamble

These principles were collaboratively developed by a team of dedicated professionals representing industry, conservation organizations, land management agencies, and independent scientists. These principles for restoration should be used as guidelines for project development and they represent the "zone of agreement" where controversy, delays, appeals, and litigation are significantly reduced. They may be appropriate for application to specific restoration projects in the southwestern United States. Projects using these principles should be driven primarily by ecological objectives while promoting economic and social benefits.

Participants

The Nature Conservancy in New Mexico
Natural Resources Conservation Service
Bureau of Land Management
Sierra Club, Rio Grande Chapter
Forest Guardians
New Mexico State Forestry Office
U.S. Forest Service
Bureau of Indian Affairs
New Mexico State Land Office
Forest Guild
Center for Biological Diversity
Restoration Solutions
Public Service of New Mexico

Principles

1. **Collaborate**. Landscape scale assessment, and project design, analysis, implementation and monitoring should be carried out collaboratively by actively engaging a balanced and diverse group of stakeholders.
2. **Reduce the threat of unnatural crown fire.** A key restoration priority must be moving stands toward a more natural restored condition and the reduction of the risk of unnatural crown fires both within stands and across landscapes. Specific restoration strategies should vary based upon forest vegetation type, fire regime, local conditions, and local management objectives. Forests and woodlands characterized by infrequent and mixed-severity fire should be managed for stand structure consistent with their historical ranges of variation—including, in some cases, high-density, continuous stands. Discontinuous stand structure may be appropriate in areas such as the wildland urban interface for these forest and woodland types.
3. **Prioritize and strategically target treatment areas**. Key considerations for prioritizing restoration treatment areas are: degree of unnatural crown fire risk, proximity to human developments and important watersheds, protection of old-growth forests and habitats of federally threatened, endangered, or listed sensitive species, and strategic positioning to break up landscape-scale continuity of hazardous fuels. Treatments should be done at a landscape scale to decrease forest vulnerability to unnatural stand-replacing fire. This priority-setting should take place during fire management planning, land management planning, and community wildfire protection planning.
4. **Develop site-specific reference conditions.** Site-specific historical ecological data can provide information on the natural range of variability for key forest attributes, such as tree age structure and fire regimes that furnish local "reference conditions" for restoration design. A variety of constraints, however, prevent the development of historical information on every hectare of land needing restoration. General goals should be to restore ecological integrity and function.
5. **Use low-impact techniques.** Restoration treatments should strive to use the least disruptive techniques, and balance intensity and extensiveness of treatments. In many areas, conservative initial treatments would be the minimum necessary to adequately reduce the threat of unnatural crown fire. Wildland fire use or management ignited fires may be sufficient to reestablish natural conditions in many locations. In the extensive areas where fire alone cannot safely reduce tree densities and hazardous ladder fuels, mechanical thinning of trees may be needed before the introduction of prescribed fire. Patient, effective treatments will provide more options for the future than aggressive attempts to restore 120 years of change at once. In certain areas, however, such as some urban-wildland interfaces, trade-offs with imminent crown fire risks require considerations of rapid, heavy thinning of mostly small-diameter trees.
6. **Utilize existing forest structure.** Restoration efforts should incorporate and build upon valuable existing forest structures, such as large trees, and groups of trees of any size with interlocking crowns excluding aspen. These features are important for some wildlife species, such as Abert's squirrels and goshawks, and should not be removed completely just to recreate specific historical tree locations. Since evidence of long-term stability of precise tree locations is lacking, especially for piñon and juniper, the selection of "leave" trees and tree clusters in restoration treatments can be based on the contemporary spatial distribution of trees, rather than pre-1900 tree positions. Maximizing use of existing forest structure can restore historical forest structure conditions more quickly. Leaving some relatively dense within-stand patches of trees need not compromise efforts to reduce landscape-scale crown fire risk.

   The underlying successional processes of natural tree regeneration and mortality should be incorporated into restoration design. Southwestern conifer regeneration occurs in episodic, often region-wide pulses, linked to wet-warm climate conditions and reduced fire occurrence. Periods with major regeneration pulses in the Southwest occurred in the 1910s–1920 and in 1978–1998. Some of this regeneration would have survived under natural conditions. Restoration efforts should retain a proportion of these cohorts.
7. **Restore ecosystem composition.** Missing or diminished compositional elements, such as herbaceous understories, or extirpated species also require restoration attention. The forest understory, including shrubs, grasses, forbs, snags, and down logs, is an important ecosystem component that directly affects tree regeneration patterns, fire behavior, watershed functioning, wildlife habitat, and overall patterns of

biodiversity. Similarly, soil organisms, such as mycorrhizal fungi, are vital elements that can influence community composition and dynamics. A robust understory provides a restraint on tree regeneration and is essential for carrying surface fires. The establishment and maintenance of more natural patterns of understory vegetation diversity and abundance are integral to ecological restoration.

Restoration planning should include the conservation of habitats for diminished or extirpated wildlife species. Comprehensive forest ecosystem restoration requires balancing fire risk reduction with retention of forest structures necessary for canopy dependent species.

Recovery plans and conservation plans for threatened, endangered, and sensitive species should be incorporated to the fullest extent possible in planning for comprehensive forest restoration.

8. **Protect and maintain watershed and soil integrity.** Low impact logging techniques will minimize sedimentation, disruption of surface runoff, and other detrimental ecosystem effects. Equipment and techniques should be managed according to soil and water conservation "best management practices" applicable to site-specific soil types, physiography and hydrological functions.

   Reconstruction, maintenance, or decommissioning of existing roads to correct for poor hydrologic alignment and drainage condition can greatly reduce soil loss and sedimentation rates. Projects should strive for no net increase in road density.

   Managing forest density and fuels to avoid uncharacteristically intense wildfire events will reduce the likelihood of catastrophic post-fire soil erosion and nutrient depletion from forested landscapes. Soil productivity should be protected and maintained by avoiding soil loss and compaction, and managing for on-site nutrient retention. Avoid repeated whole tree biomass removal from the forest to maximize nutrient retention. Whenever feasible, green foliage should be recycled by scattering on site; followed by prescribed burning to release stored nutrients.

9. **Preserve old or large trees while maintaining structural diversity and resilience.** Large and old trees, especially those established before ecosystem disruption by Euro-American settlement, are important forest components and critical to functionality of ecosystem processes. Their size and structural complexity provide critical wildlife habitat by broadly contributing crown cover, influencing understory vegetation patterns, and providing future snags. Ecological restoration should manage to ensure the continuing presence of large and old trees, both at the stand and landscape levels. This includes preserving the largest and oldest trees from cutting and crown fires, focusing treatments on excess numbers of small young trees.

   Develop "desired" forest condition objectives that favor the presence of both abundant large diameter trees and an appropriate distribution of age classes on the landscape, with a wide distribution of older trees. It is generally advisable to maintain ponderosa pines larger than 41 cm (16 inches) diameter at breast height (dbh) and other trees with old-growth morphology regardless of size (e.g. yellow-barked ponderosa pine or any species with large drooping limbs, twisted trunks or flattened tops).

   Treatments should also focus on achievement of spatial forest diversity by managing for variable densities. Overall, forest densities should be managed to maintain tree vigor and stand resiliency to natural disturbances. Disease conditions are managed to retain some presence of native forest pathogens on the landscape, but constrained so that forest sustainability is not jeopardized. Guidelines must provide opportunities to apply differing site-specific management strategies to work towards attainment of these goals, and recognize that achievement may sometimes require more than one entry.

   Stand level even-aged management may be appropriate for some objectives, including disease management, post wildfire tree regeneration, accelerating development of old growth characteristics, or for, forest types for which even-aged stands are characteristic, such as spruce or aspen. Treatments should be identified through collaboration with key stakeholders.

   Some ponderosa pine forests contain extremely old trees and dead wood remnants that may be small but are important because they contain unique and rare scientific information in their growth rings. Such trees have become increasingly rare in the late 20th century, and the initial reintroduction of fire often consumes these tree-ring resources. Restoration programs should preserve them where possible.

10. **Manage to restore historic tree species composition.** Forest density levels and the presence of fire in the ecosystem are key regulators of tree species composition. Where fire suppression has allowed fire-sensitive trees like junipers or shade-tolerant white fir or spruce to become abundant in historical ponderosa pine forests, treatments should restore dominance of more fire-resistant ponderosa pines. However, fire intolerant species sometimes make up the only remaining large tree component in a stand. Retention of these large trees is important to canopy dependent wildlife species. In mixed conifer forests, landscapes should be managed for composition and structure that approximates the natural range of variability.

11. **Integrate process and structure.** Ecological sustainability requires the restoration of process as well as structure. Natural disturbance processes, including fire, insect outbreaks, and droughts, are irreplaceable shapers of the forest. In particular, fire regimes and stand structures interact and must be restored in an integrated way; mechanical thinning alone will not reestablish necessary natural disturbance regimes. At the same time, fire alone may be too imprecise or unsafe in many settings, so a combination of treatments may often be the safest and most certain restoration approach.

    The single best indicator of whether a proposed approach should be considered as "ecological restoration" is to evaluate if the treatment would help successfully restore the fire regime that is natural for that forest type. Approaches that do not restore natural fire regimes will not achieve full ecological restoration.

12. **Control and avoid using exotic species.** Seeding of exotic grasses and forbs should be prohibited as ecologically incompatible with good restoration. Once established, exotic species can be extremely difficult or impossible to remove. Seeding should be conducted with certified or weed free seeds to reduce the risk of contamination by non-native species or varieties.

    In general, it is ecologically desirable to allow native herbaceous vegetation to recover incrementally unless there is potential for serious soil erosion or the potential for establishment of non-native invasive plants. If enhancement of herbaceous vegetation is needed, especially for road closures and recovery, using locally sourced native seeds or transplanting individuals from nearby areas into treatments is ecologically desirable.

    Restoration treatments should also routinely incorporate early actions to control the establishment and spread of aggressive exotics that can be expected from restoration-related site disturbance.

13. **Foster regional heterogeneity**. Biological communities vary at local, landscape, and regional scales, and so should restoration efforts. Ecological restoration should also incorporate the natural variability of disturbance regimes across heterogeneous landscapes. Heterogeneity should be fostered in planning and implementing ecological restoration and all spatial scales, including within and between stands, and across landscape and regional scales.

14. **Protect sensitive communities**. Certain ecological communities embedded within ponderosa pine or other types of forests and some riparian areas, could be adversely affected by on-site prescribed burning or mechanical thinning. Restoration efforts should protect these and other rare or sensitive habitats, which are often hotspots of biological diversity, particularly those that are declining in abundance and quality in the region.

15. **Plan for restoration using a landscape perspective that recognizes cumulative effects**. Forest restoration projects should be linked to landscape assessments that identify historical range of variation (reference condition), current condition, restoration targets, and cumulative effects of management. Ecosystems are hierarchical; changing conditions at one level arise from processes occurring at lower levels, and are constrained, in turn, by higher levels. The landscape perspective captures these complex relationships by linking resources and processes to the larger forest ecosystem. Forest restoration projects should incorporate plans for long-term maintenance of ecological processes.

16. **Manage grazing.** Grass, forbs, and shrub understories are essential to plant and animal diversity and soil stability. Robust understories are also necessary to restore natural fire regimes and to limit excessive tree seedling establishment. Where possible, defer livestock grazing after treatment until the herbaceous layer has established its current potential structure, composition, and function.

17. **Establish monitoring and research programs and implement adaptive management**. Well-designed monitoring, research, and documentation are essential to evaluate and adapt ongoing restoration efforts. Monitoring programs must be in place prior to treatment, and must evaluate responses of key ecosystem components and processes at multiple scales. Use research and monitoring results from a variety of sources to adjust and develop future restoration treatments.

    When possible, restoration projects should be set up as experiments with replicates and controls to test alternative hypotheses. The locations and prescriptions for all restoration treatments should be archived in a geographic information system, so that land managers and researchers have access to site-specific records of restoration treatments.

18. **Exercise caution and use site-specific knowledge in managing persistent pinon-juniper woodlands, piñon-juniper savannas, and areas of potential expansion and contraction.** These systems are diverse and complex. Knowledge of local reference structure, composition, processes and disturbance regimes is lacking or uncertain for many piñon–juniper ecosystem types. Given the diversity, variability, and complexity of pinon-juniper systems, identification of local reference conditions is critical to the development of restoration objectives. Exercise caution and use best available science and site-specific knowledge in planning and implementing ecological restoration projects.

Active management may be appropriate to mitigate soil erosion, community wildland fire hazard, or degraded hydrologic functioning in cases where historical ecological dynamics are insufficiently understood to justify ecological restoration.

Piñon-juniper sites may be particularly susceptible to ecological damage–from treatments, for example, soil erosion and invasion by non-native plants.

Use the Grassland and Woodland Restoration and Management Framework for development and implementation of specific projects (The Framework is currently under development).